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RECENT STUDIES OF CARNIVOROUS PLANTS.[1]

BY JARED G. SMITH.

N. Tischutkin published an article in 1889 in the *Berichte der Deutschen Botanischen Gesellschaft* on the cause of the digestion of albumen by the leaves of *Pinguicula vulgaris* L. in which he endeavors to show that the process of digestion is the result of the action of Bacteria. This is in opposition to the theory of Darwin and other authors that the digestion is analogous to the digestion by means of pepsin in the animal kingdom.

In an article in volume XII of the *Acta Horti Petropolitani* he further discusses the subject and concludes that the pepsin of the leaves of insectivorous plants is not a secretion of the plants themselves but is a by-product formed by the numerous species of Bacteria found in the digestive fluid.

In his former study Tischutkin performed over one hundred and fifty experiments, using extracts from the leaves of Pinguicula and small amounts of the secretions of the insect catching leaves. Into these extracts and secretions he put small cubes of coagulated egg albumen. In no case did there follow any peptonization of the egg albumen. These results impelled him to take up the further study of the relation of micro-organisms to the digestion of albuminous compounds by insectivorous plants, using other species and genera.

[1]Shaw School of Botany, St. Louis. Read before the Botanical Seminar of the University of Nebraska, Feb. 18, 1893.

Certain authors who have investigated the digestive process (among them Darwin, Gorup, Besanz, Reess and Will) have concluded that it is the result of pepsin secreted by the plants. Others, as C. Morren, see only a process of rotting and decay. Tischutkin in his former paper has reviewed the methods by which these various authors have arrived at their results. Morren placed on the leaves of *Drosera binata* Labill. different insects and cubes of coagulated egg albumen and observed that a few hours afterward the albumen became transparent, the angles were rounded off, and after a day or two the pieces entirely disappeared. Microscopic examination of the transparent fragments of albumen revealed the presence of bacteria, monads, and filaments of a mycelium which resembled the conjugating stage of some species of Mucorineæ. He concludes that while this dissolving of the albumen by some absorbent principle is possible, the intervention of pepsin is entirely problematic.

Schimper in the *Botanische Zeitung* for 1882 tells of some experiments which he made with *Sarracenia purpurea.* These are of great value because made on plants growing wild in Massachusetts. A part of the observations were made on insects caught by the plants, and a part by placing pieces of meat on the leaves. He found that on stopping up the mouths of the leaves at their time of opening and thus preventing the free entrance of bacteria the digestion took place no more rapidly than when the bits of meat were placed in pure water, and from this fact he concluded that pepsin was not present. He did not test the liquid by chemical means. He found great numbers of worms in many of the leaves and thinks that they may have something to do in rendering organic matter absorbable.

Hildebrandt in the *Botanische Zeitung* for 1870 tells of the experiments made on the leaves of *Dionæa muscipula* Ell. and on the cups of *Sarracenia, Cephalotus* and *Nepenthes.* He doubts very much whether the insects caught are of value to the plants. "My observations on *Dionæa muscipula* showed me that the long legged spiders which are caught in the leaves exert an injurious influence upon them. A slimy fluid

would be secreted, but after a short time the leaves would commence to die, if I had not removed the spider in time."

Aschman in 1875-6 in his work on insectivorous plants throws doubt on the presence of pepsin in the secretions of Nepenthes and Sarracenia, and believes that the digestive process is simply putrefaction.

Thus we see that many authors have expressed the opinion that the digestion of nitrogenous substances by the secretions of the leaves of insectivorous plants is due to disintegration through the action of the lower organisms rather than by active ferments produced by the plant itself.

Following this preliminary statement of the published data of the subject, Tischutkin takes up his own experiments and gives the results which he has obtained.

The objects which he kept in view while making these experiments were, first, to see whether the presence of lower organisms in the secretions was a constant occurrence; second, if uniformly present, could these organisms dissolve albumen; and, third, to compare the results obtained with other insectivorous plants with *Pinguicula vulgaris*. The plants used were *Pinguicula vulgaris*, *Drosera longifolia*, *D. rotundifolia*, *Dionæa muscipula* and *Nepenthes mastersii*. All of these plants, the last excepted, were cultivated under bell-jars to prevent the visits of insects. To procure the secretion he excited the glands by means of cubes of sterilized egg albumen. The leaves of the first three species responded once to the irritation, those of *Dionæa muscipula*, three times. The acid sap thus obtained was examined microscopically every 24 hours for five days. In every case great multitudes of bacteria were discovered, and frequently there were various moulds as well. The author considers this discovery of much importance, because Darwin had stated that the secretions possess antiseptic properties which prevent the rapid appearance of microorganisms, and compared their action with that of the gastric juice in the higher animals, which, as is well known, destroys injurious and decay-producing lower organisms.

Gelatine cultures were made in the usual manner, using a drop of the secretion from Dionæa and Drosera 24 hours

after the commencement of the experiment. After the development of from nine to ten generations on Fleisch-Peptone-Gelatine, the different species of bacteria were transferred to test tubes which contained dilute acid peptone-free meat bouillon. Control experiments were made with test tubes containing sterilized water acidulated with dilute hydrochloric acid. Into each test tube was placed a small cube of sterilized egg albumen. In all of those test tubes in which the bacteria developed there followed a rapid solution of the egg albumen commencing at the surface of the cubes and invariably continuing to their centers until solution or peptonization was complete.

By these experiments the author proved that bacteria which possess the power of dissolving egg albumen are always present in the secretions of insectivorous plants.

The number of species that had this power were:

In *Pinguicula vulgaris*, 4 species.
In *Drosera longifolia*, 2 species.
In *Drosera rotundifolia*, 1 species.
In *Dionæa muscipula*, 2 species.
In *Nepenthes mastersii*, 2 species.

His next experiments were made using the leaves of Nepenthes, where comparatively large quantities of the fluid could be procured without special irritation. He examined fully developed pitchers of *Nepenthes mastersii* and *N. kennedyana*. The reaction of the secretion was neutral. The secretion contained neither peptone nor insects, and yet there were vast numbers of micro-organisms. The liquid from a leaf of each species was poured into two test tubes, one acidulated with dilute hydrochloric acid, the other without addition of acid. A small cube of coagulated egg albumen was placed in each test tube, and they were then placed in a thermostat at a temperature of 37.5° C. At the end of sixteen hours the egg albumen in the tubes to which hydrochloric acid had been added, had commenced to dissolve, but in the other two was unchanged. This experiment was made to satisfy himself concerning the truth of observations made by Gorup, Besanz and Will that the secretion of unirritated pitchers possessed the property

of peptonizing egg albumen only after it had passed from neutral to acid reaction. He further says that it is extremely improbable that this peptonizing principle is secreted by the glands of the Nepenthes pitchers, but that it is produced by certain micro-organisms present in the solution. Hence the digestion that takes place is not analogous to digestion of albuminoids in the stomach of man, because in the latter case the secretion of gastric juice follows as a result of direct irritation.

To demonstrate this more fully he repeated his experiments in a modified form, using a neutral secretion which contained no bacteria. For this purpose he selected two unopened cups of *Nepenthes coccinea* and *Nepenthes*——sp. ?——which were so far developed that the liquid was already present in considerable quantity. The leaves were separated from the plant and the petioles were attached to a ring stand so that the pitcher of the leaf was vertical. The outside of each pitcher was disinfected with a freshly prepared 1:1000 sublimate solution in water. After the water of the sublimate solution had partially evaporated, a small hole 3 mm. in diameter was cut in the wall of the pitcher with a pair of sterilized scissors. The secretion from each was then transferred by means of a sterilized pipette into two test tubes each containing two cubic centimeters of distilled water and a small cube of coagulated egg albumen. One of the test tubes was slightly acidulated with hydrochloric acid, the other remained neutral. The four test tubes were then placed in a thermostat at 37.5° C.

At the end of 48 hours there was no solution of the egg albumen, though a control experiment with a test tube containing pepsin gave positive results. Microscopic examination and gelatine cultures gave negative results. These experiments were repeated, using the remainder of the secretion diluted with a little pure glycerin, but the result was the same.

In these experiments the only question that could be raised was whether the pitchers from which the secretion was taken were not too young to contain pepsin. But if one remembers the experiments of Wunschmann in 1872, and also considers

that the cups were more than half filled, there can be little doubt on this ground.

To obviate this objection the experiment was repeated in another way. Two cups were taken, the one from *Nepenthes distillatoria* and the other from *N. hirsuta*, which were still closed but appeared to be just ready to open. Considerable secretion was present. The cups were not separated from the parent plants. The wall of the cup was sterilized with a sublimate solution which was washed away with sterilized water. Then a small V shaped opening was cut in the wall above the surface of the liquid. Through this opening in the wall of the cup a piece of sterilized egg albumen one centimeter long and one millimeter thick was introduced into the cup of *N. hirsuta* and a piece ¼ cm. long and 1 mm. thick, into that of *N. distillatoria*. The openings in the walls were then covered with pieces of court plaster, and these for protection from the moisture of the culture house were covered with varnish. After four days the cups opened. The pieces of egg albumen were unchanged, not even the corners being rounded off. Pepsin was not present in the secretion and bacteria only in very small numbers.

The secretion from each cup was then poured out into sterilized test tubes containing small pieces of white of egg, and they were set aside at a temperature of 20-22° C. The white of egg in the secretion from *N. distillatoria* was dissolved in four days, that in the secretion of *N. hirsuta* in five. At the same time enormous quantities of bacteria were developed.

After finishing these experiments the author noticed an article in the *Comptes Rendus* for 1890, by Dubois, who had experimented with the secretions of various Nepenthes species taken before the cups had opened. Dubois's results agree with those of Tischutkin. The secretion taken from the cups just as they were ready to open did not contain pepsin and did not affect the cubes of albumen. But after having been exposed to the air for some time, putrefaction commenced and the resultant liquid contained traces of pepsin. Dubois draws the following conclusions from his experiments.

1st. That the secretion of Nepenthes does not contain any pepsin and that Nepenthes is not an insectivorous plant.

2d. That the phenomenon of disintegration, called "digestion" by Hooker, was without doubt due to the presence of micro-organisms and not to the secretions of the plant itself.

The author finds that the results of his various experiments show that all the disintegration of nitrogenous substances by the leaves of insectivorous plants is *directly dependent* upon the presence of certain lower organisms, principally bacteria, in the secretions of the plants.

The secretion contains bacteria of many different species, micrococci and rod-shapes, and sometimes the mycelia of moulds or other fungi. It is evident that most of these organisms are carried into the cups by the air, though some may be washed in by rain drops or carried on the bodies of insects. The solution of albuminous compounds commences simultaneously with the development of great numbers of micro-organisms in the secretion.

The secretion of the leaves of insectivorous plants is not analogous to the gastric juice of the higher animals. It is only a medium in which bacteria may live and develop while they are breaking up nitrogenous organic insoluble compounds and preparing them for assimilation by the plant.

It will not be uninteresting to present a table showing the chemical composition of the secretion of various Nepenthes species. The calcium and magnesium are in composition with malic and citric acids.

Malic acid and a trace of citric acid	38.61 %
Potassium chloride (Chlorkalium)	50.42
Sodium carbonate	6.36
Calcium	2.59
Magnesium	2.59
Organic matter—a trace	
	100.57.

There are no free acids in the liquid, though Dr. Turner in 1828 reported a trace of oxalic acid.

Without doubt these genera constitute a group entirely unique. They furnish great natural bacteriological laboratories in which the cultivation of microbes which are beneficial to the plant is carried on. It is in a certain sense a symbiosis between the lowest and the most highly organized plants. The higher organisms furnish a food supply for the use of the microbes in order that they may in turn be benefited by food stuffs which the lower organisms manufacture and furnish in convenient form. That the nitrogenous compounds set free by the dissolution of the egg albumen are really absorbed is shown by Darwin in his experiments.

On the ground of his experiments the author offers his conclusions as follows:

1st. The disintegration of albuminous compounds by the secretions of carnivorous plants is due to the growth of micro-organisms, principally bacteria.

2. Micro-organisms possessing the power of dissolving albuminous compounds always vegetate in the secretions of completely developed carnivorous plants.

3. The disintegration of the albumen does not commence at the moment of the secretion of the fluid, but only after micro-organisms have developed in sufficient numbers in the secretion.

4. The micro-organisms found on the leaves of carnivorous plants come principally from the air, though they may be derived from other sources.

5. The name "carnivorous" plants is to be understood in the sense that the plants only assimilate the products which the lower organisms have set free.

6. The rôle of the plant itself is only to furnish a medium in which certain micro-organisms may live and develop.

A NEW THEORY OF THE MECHANICAL EVOLUTION OF THE METAPODIAL KEELS OF DIPLARTHRA.

By J. L. Wortman, M. D.

In the last number of the Journal of Morphology, Mr. Austin Carey gives the results of his studies in the foot structure of the Ungulates. A fair statement of his main conclusions, or rather perhaps the pith and substance of his argument is to be found in the concluding sentence of his article which reads as follows: "That the lines of evolution have progressed with but few useless side variations seems to be the uniform testimony of paleontologists; but that race changes follow those produced in individual life, or that they are directly caused by their mechanical surroundings, I do not think has been satisfactorily shown."

It is not my intention to enter here into a criticism or general discussion of the points this author has raised in his argument, nor will I undertake to discuss at this time the broad question of the transmission of acquired characters. I do, however, wish to say a few words upon the question of the production of crests and keels upon the distal extremities of the metapodial bones. Upon this point Mr. Carey says, (p. 341) "The crests and grooves on the lower metacarpal ends in some forms, produced apparently in relation to the sesamoid bones, is one of the most marked examples of probable mechanical evolution." "But before such structures can be said to prove the inheritance of acquired characters, the question should be tested whether they are not produced somewhere in the history of each individual by the necessary interaction of parts." He further adds in a footnote that "The crests in certain highly specialized forms, like the horse and deer, reach round to the anterior face of the bone and apparently cannot thus be interpreted or assigned to any mechanical origin that is obvious."

With reference to Mr. Carey's first proposition that these metapodial crests are produced during the life of each individual by the necessary interaction of parts, it appears to me to be a very simple one indeed. If they are produced, by pressure during the lifetime of each individual, and are not inherited, then clearly we should find the crests absent in new born animals that had never walked, and in which the metapodials had not been subjected to any impact or pressure whatever. I have taken the trouble to examine a number of such examples in which the distal ends of the bones were entirely cartilaginous, and I find that the keels and grooves are as well developed as they are in the adult animal. I will cite one case in particular in which I happen to know the history completely. During the past winter, a young hippotamus was born in the Zoological Gardens in Central Park, and it was stated to have been a premature birth; the animal lived but twenty-four hours, and I was informed by the keeper that it never stood upon its feet. An examination of the feet shows that the distal ends of the metapodials are entirely cartilaginous, and in them the keels are as well prefigured in cartilage as they are performed in bone in the adult animal. I have also found the same to be true of newborn rabbits and guinea-pigs. In another case of a young buffalo calf preserved in the American Museum Collection, the distal keels of the metapodials are complete notwithstanding the fact that the epiphyses of all the bones are very imperfectly ossified. This evidence, it appears to me, effectually disposes of the question of the production of these structures during the lifetime of the individual. They are as truly inherited as is the number of digits or any other important organ in the animal economy.

Mr. Carey further states in his concluding remarks that "Plasticity of bone, using the word *plasticity* not in a physical sense merely, but to include absorption under pressure, will probably account for much structure in the foot and elsewhere, especially in connection with the joints and in the field of variation and correlation." Now just what Mr. Carey means by "absorption under pressure" is not clear to my mind. If he means a process similar to that of the absorption of the roots

of the temporary or milk teeth, then the term "under pressure" is especially inappropriate, since Tomes has shown[1] that this process is entirely independent of pressure of any kind whatever, but is in some way connected with the presence of "myeloid" or "giant" cells. The only other process of "absorption under pressure" with which I am acquainted, is a pathological one. In this case the pressure is sufficiently severe to cut off entirely, or seriously affect the supply of nutrition, thereby causing the death of the part and its subsequent removal by sloughing. This however may be very gradual, so gradual in fact, as to resemble a perfectly normal change, as is often seen in the pressure of an aneurismal sac upon a neigboring bone. It may be true that a process of this nature, having its origin in a strictly pathological cause, may have become normal. Indeed, Huxley has remarked[2] that it is not always easy to draw the line between pathological and normal changes. Upon the whole, however, it seems to me that before we can admit this principle of "absorption under pressure" as having played any important part in the modification of the skeleton, we must require further proof of its existence and its method of operation.

That living bone tissue is plastic, I should say *highly* plastic and that too in the ordinary physical sense, is so abundantly demonstrated upon every hand, that no further argument is necessary to establish the truth of this proposition. It is recognized and acted upon in everyday surgical practice, and the number of cases wherein entirely new joints have been formed in old dislocations, leaves nothing to be desired to complete the proof. The changes thus produced however, have all occurred within the lifetime of the individual and it yet remains to be proven that they are capable of transmission to succeeding generations.

With reference to the production of the metapodial keels or crests, Cope has explained it in the didactyle foot at follows[3]: "A similar cause produces a similar result in the development

[1]Dental Anatomy, p. 197

[2]Address to the British Medical Association, London Lancet.

[3]The Artiodactyla, American Naturalist, March 1889, p. 115.

of the tongue and groove articulation between the metapodials and first phalanges. In alighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce upon each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle, and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth on alighting. The pinching of a keel by its groove takes place at all points in the length of the former, reached by the opposite sides of the extremities of the latter during flexion and extension. This keel becomes acute and prominent in the Boöidea and extends to the anterior face of the condyle. This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these two bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a median trochlear surface exists at the distal extremity of the first phalanx in all mammals. But a single flexor tendon crosses this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as is the case of the patella and the rotular groove of the femur."

In support of Cope's proposition, that the development of crests or keels upon the plantar or palmar aspect of the distal end of the metapodials, is due primarily to the presence of two sesamoids imbedded in the flexor tendons, I can add that in every case where these sesamoids are present, and pressure is exerted by the flexure of the phalanges upon the metapodials, the keels are developed, and conversely, that where the sesamoids are absent or are present without pressure, the keels are absent. The human foot and hand are

excellent examples of this. In the foot there are two sesamoids developed in the tendons of the *flexor brevis hallucis* as they pass over the end of the metatarsal of the great toe, to be attached to the phalanx. Now in the act of walking the greater part of the weight of the body falls upon this digit and as the heel is raised and the foot is brought into a more or less vertical position, these tendons are put upon the stretch and pressure results; in this metapodial, therefore, we find the keel present. In the other digits the sesamoids are absent and there is no keel developed. In the upper extremity there are sesamoids developed in the tendons of the *flexor brevis pollicis* at the metacarpo-phalangeal articulation, but owing to lack of pressure the keel is absent. Again in the Spider Monkey there are two sesamoids present in the tendons of the short flexors of the great toe and the keel is developed, while in the other digits there are no sesamoids and no keels. In other species of monkeys on the other hand such as the Macaques, the sesamoids are present and the keels are developed upon all the metapodials. These monkeys are said to be less arboreal in their habits, which would explain the difference in the matter of sesamoids and keels. Among the Marsupials there is no patella in the Vulpine Phalanger, and here we find that the rotular groove of the femur is very little developed. The hallux is without the sesamoids and there is no keel, notwithstanding the fact that there are both sesamoids and keels in the other metapodials. These cases could be multiplied indefinitely showing the same results. I have in fact failed to find a *single example of a metapodial*, in which sesamoids are present and pressure is exerted, *which does not show the presence of the primary keel.*

I will now consider Mr. Carey's other proposition viz: that the crests or keels in certain highly specialized forms reach around to the anterior face of the bone, and are not explainable by, nor cannot be assigned to any mechanical reason that is obvious. I must say that when I met with this problem several years ago, I was somewhat at a loss to understand how any mechanical explanation could possibly be applied to its Professor Cope's explanation of the extension of these keels in

the didactyle foot may possibly be the correct one, but I am inclined to doubt it seriously. It certainly cannot apply to the monodactyle foot since it is inconceivable that any "pinching" could occur in flexion and extension of the phalanges upon the metapodials; for the reason that there is no spreading such as he describes in the didactyle foot. It is moreover manifestly impossible that the sesamoids could have come into play to form the keel, because the amount of extension necessary to bring them into the proper position would be so great as to cause complete dislocation of the phalanx. How then can this extension of the keels be explained upon the basis of mechanics?

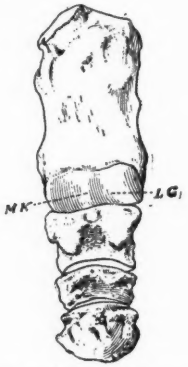

FIGURE 1.—*Coryphodon*, Median digit of the Manus, posterior view. (Coll. Am. Mus. Nat. Hist.)

In the first place it is necessary to call attention to the fact that at least three positions have been assumed in the various stages of the evolution of the ungulate foot, viz: a plantigrade or subplantigrade position, in which not only the phalanges but the metapodials are applied to the ground in walking, as in the hind feet of *Coryphodon* and all the earlier forms; second, a digitigrade position, in which only the phalanges are applied to the ground in walking, as in such forms as the tapir, rhinoceros and the earlier representatives of the horse series; and finally the unguligrade position in which the weight of the body is supported entirely upon the terminal or ungual phalanges. This position of the foot

belongs to the higher forms of both the odd and the even-toed ungulates. Now if we attempt to trace the history of the metapodial keels in the evolution of such a form as the horse, no one will deny, it seems to me, that we have here an unusually complete phylum represented, which clearly indicates the different stages in their development. In the earlier members of this series, such for example as *Hyracotherium*, the keels are confined to the plantar and palmar surfaces of the metapodials, and the animal was subdigitigrade. In such a form as *Mesohippus*, on the other hand, we pass from the digitigrade position of the foot to that of the unguligrade, wherein the weight of the body was supported upon the terminal phalanx or coffin bone. Just what induced this change is unknown, but it is more than probable that it was in some way connected with the reduction of the lateral toes.

We do not yet know with certainty the ancestors of the horse series beyond *Hyracotherium*, but there can be little doubt that the feet were pentadactyle and plantigrade. So far at least as the metapodials are concerned, we have such a condition in *Coryphodon*, in which the keels are but faintly indicated, and the two lateral grooves of which the primary keel forms the common median wall, are in the first stages of development. There is every reason to believe that this animal was plantigrade or subplantigrade in gait, and that the failure to develop the keels was due to the more equal distribution of the strain upon all the digits. This is true of the foot of the elephant in which we observe another structure which has certainly had much to do with the retardation of keel development viz: a very thick plantar pad. The possession of this pad not only tends to distribute the strain and equalize the pressure but at the same time limits the amount of flexion and extension of the phalanges. It is a fact worthy of especial note, and one which I will make use of later on, that in all these forms wherein the lateral grooves and keels are very little developed, the plantar border of the arcticular surface of the first phalanx is not at all notched. It is also to be noted that the feet are short and spreading.

With the assumption of the digitigrade position however, the plantar pad was reduced, the foot became more elongated, and the strain became more localized. In this position of the foot the weight of the body falls upon the phalanges, which are now bent at a considerable angle upon the metapodials, and an especial strain is produced by the flexor tendons where they pass over the distal ends of the metapodials. In a foot of this type therefore, do we find a considerable advance in the development of the median keel and lateral grooves of the metapodials? Those of the third digit are most advanced for the reason that the strain is more concentrated and localized

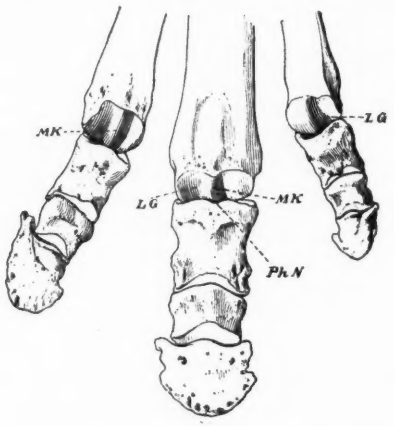

FIGURE 2.—Modern Tapir. Posterior or plantar surface of the hind foot.

at this point. In none of the metapodials however, do the lateral grooves and keel extend more than half-way around the articular ends, nor does the keel rise but little above the lateral boundaries of the grooves. This is well shown in such forms as the tapir, rhinoceros, *Hyracotherium* and nearly all the Eocene Perissodactyla. While the foot remained in the digitigrade position, the median keel of the metapodials made little or no impression upon the lower edge of the articular surface of the proximal phalanx, for the reason that the main flexure of the foot was between the first phalanges and the

metapodials, which would throw the keels so far back as to seldom come in contact with the proximal phalanx. In the middle toe or third digit, of the digitigrade foot however, the main flexure of this toe is momentarily transferred from the articulation between the metapodial and first phalanx to that between the second and third phalanges in the act of walking, and this straightening out of the first two phalanges, so as to bring them in a line with the long axis of the metapodial, has caused the keel to impinge upon the lower edge of the articular surface of the first phalanx which has become distinctly notched.

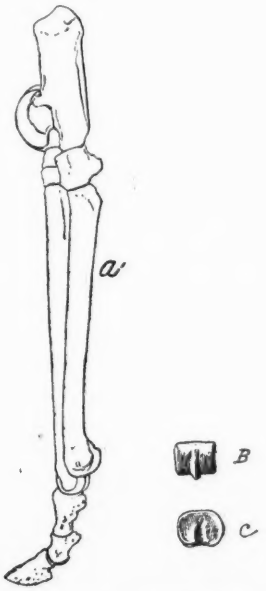

FIGURE 3.—*Mesohippus.* Outer view of the left hind foot. B, Distal surface of median metatarsal, C, Proximal surface of median first phalanx. (Collection Amer. Mus. Nat. Hist.)

It follows that in such forms as the tapir, rhinoceros, *Hyracotherium*, and in fact in all of the truly digitigrade Perissodactyla, the first phalanx of the median digit is always

slightly notched, while the first phalanges of the lateral digits are without the notch. This is an important fact, and in connection with what has just been said of *Coryphodon*, I think that it may be accepted as demonstrated, that the formation of this notch is due to the impact of the keel upon the lower border of the phalanx. Up to this stage therefore, we have the following conditions, viz: a comparatively low primary keel bounded upon either side by well marked lateral grooves whose outer borders are as much elevated as the keel. We also note that the grooves and keel extend but half-way around the end of the metapodial, and that the lower edge of the first phalanx in the middle toe is distinctly notched. This may be termed the digitigrade stage in the development of the keel.

In the next or unguligrade stage of this development, beginning with *Mesohippus*,[1] the foot changed from the digitigrade to the unguligrade position in which the main flexure of the foot was transferred to the articulation between the two last phalanges, and the two proximal phalanges came to occupy a position in line with the long axis of the metapodial. It is in this genus therefore, that we find the first distinctive evidence of an advance of the metapodial keel around the lower surface toward the dorsal aspect of the bone. While this advance or extension of the keel is slight, it is interesting to note that the notch in the first phalanx, which we see just beginning in the tapir, has now been transformed into a groove and extended nearly across the articular face of the bone. We are thus able to demonstrate that, in the further extension of the keel of the metapodial beyond that of the digitigrade stage, *the groove was formed in the phalanx first.* It is to be further noted that the keel has become prominent and that the lateral grooves of the metapodials are almost entirely obliterated, at least their outside walls have disappeared, leaving two nearly plain articular surfaces separated by a now prominent, or secondary median keel. Again, if the bones be placed in position,

[1]It is highly probable that the most incipient stages of this process are to be traced to forms somewhat older than this genus.

that is, if the first phalanx be articulated with the metapodial, it will been seen that when the phalanx is placed in a line with the metapodial or very nearly so, there is equal bearing upon all parts of the two articular surfaces of the bones ; but if the phalanx is flexed even to a slight extent, then the bearing falls largely upon the keel for the metapodial surface and the shallow groove for the phalangeal surface. When I say flexed I mean bent in the direction of the plantar side of the foot.

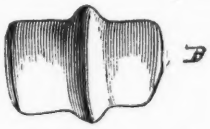

FIGURE 4.—Modern horse. Distal view of median metatarsal or cannon bone, showing complete keel.

How now can we apply these facts to the mechanical explanation of the further extension of the keel toward the dorsal side of the metapodials? When the foot assumed the unguligrade position permanently, we can understand, and have in fact already seen how the keel impinges upon and produces the notch in the phalanx. Any flexure of the phalanx upon the metapodial, under pressure would bring the keel to a more advanced position with reference to the phalangeal articulation, and would cause an extension of the notch in the phalanx so as to form a groove. That the phalanx is so flexed is evident to anyone who has ever studied carefully the movements of the foot of a horse in the act of pulling a heavy load up an inclined surface. Here the phalanx is seen to be greatly flexed when the foot strikes the ground and is therefore under great strain and pressure. I speak of it particularly in a horse pulling a load, because it is more noticeable in this case than in the unencumbered animal, but what is true of one is also true of the other. Now in an animal in which the keels and grooves were little or not at all advanced, such as was the case with the ancestor of the horse when he emerged from the digitigrade and assumed the unguligrade position of the foot, the flexure of the phalanx brought the keel forward and produced a groove in the phalanx. As the

phalanx went back to its more normal position, that is, in line with the long axis of the metapodial, there would then be a plane surface of bone lying immediately in front of the keel which would be opposed to a groove in the phalanx. An extension of the keel would necessarily follow as a result of moulding of this metapodial surface to fit the groove. Flexion, therefore, of the phalanx upon the metapodial under pressure, bringing the keel already formed to a more and more anterior position with reference to the articular surface of the phalanx, thus causing it to become grooved, and the subsequent moulding of the keel to fit this groove, I conceive to be the complete mechanical explanation of the production of this structure. The various stages in the forward extension of the keel is to be found in such series as *Hyracotherium*, *Epihippus*, *Mesohippus*, *Anchitherium*, *Hipparion* and *Equus*.

FIGURE 5.—Modern Tapir. Middle toe inside view, showing position of the phalanges upon the ground.

In the preceding discussion, only the possibility of the metapodial keels having been produced and extended forward by mechanical means, has been shown. I will now turn to the matter of the application of this reasoning to the somewhat broader question of the transmission of acquired characters, and see whether or not any argument can be adduced in support of the proposition that the development of these structures has been due *solely* to mechanical causes, and that they have in time been transmitted to succeeding generations. Upon this hypothesis it must be assumed that the changes took place first within the lifetime of the individual and that they finally came to be inherited. It must likewise be shown that wherever a groove or a keel has occurred, there must have been pressure, impact or strain, exerted at that particular point sufficient to accomplish the result. The only other pos-

sible explanation of these structures is upon the hypothesis of the accumulation of a number of spontaneous variations in this direction, entirely independently of any mechanical results acquired during the lifetime of the individual. According to this theory, all mechanical influence must of necessity, be rigidly excluded, for the reason that it is possible for it to have been exerted, or come into play only during the time that the foot was in use, and therefore, during the lifetime of the individual. If mechanical influence is admitted even to the slightest extent, then the whole proposition of the transmission of acquired characters is at once proven, and who can say how much is due to mechanics and how much to natural selection?

In the production of the completed keel and phalangeal groove, it must be shown by those who hold the theory of origin purely by natural selection that they are congenitally *correlated structures*, otherwise they must, according to the very nature of the case, have proven injurious to their possessor. In order for a keel to be useful it must be accompanied by a groove into which it is received. In other words it must be shown that any variation in the one *must have affected the other*. I shall now attempt to show that the keels and grooves are not congenitally correlated. It has been shown in the preceding pages, that the phalangeal notch which is the earliest and incipient stage of the phalangeal groove is *not* correlated with the keel. The evidence for this is to be seen in *Coryphodon*, *Elephas*, *Metamynodon*, *Titanotherium* and others in which the keel exists without any vestige of the phalangeal notch. Again, in the tapir and rhinoceros, the lateral metapodials are provided with distinct keels but the notch is absent. In the middle toe of many of the lower Perissodactyla, the keel is associated with the notch, but it was not until the foot assumed a position whereby it was possible for the keel to impinge upon the lower border of the phalanx that the notch appeared. It would indeed require a great stretch of the imagination to believe that the keel and notch were congenitally correlated structures in one toe and not in the others of

the same foot! In like manner it can be shown that neither the sesamoids, keels nor grooves of the metapodials are correlated structures, for we have seen that in the human thumb there are sesamoids present but no keels nor lateral grooves.

If upon the other hand we look at the problem from the standpoint here advocated of the mechanical explanation, or kinetogenesis, and we admit that the bone is plastic, then we are forced to conclude, it seems to me, that the lateral grooves and keels of the metapodials are the direct and unavoidable results of pressure exerted by the sesamoids. This is proven by the fact that wherever there are sesamoids present, and strong pressure is exerted, there are developed lateral grooves and median keels, and that where the sesamoids are absent, or no pressure is exerted, there are no lateral grooves nor keels. As long as the foot remained in the digitigrade position the keel did not advance, and this is demonstrated by the fact that there is no animal of this gait that has a completed keel. Up to this point the lateral grooves and keel had a distinct function, viz: to serve as guides for the sesamoids, but when the change was made in the position of the foot to that of the unguligrade, the lateral grooves began to disappear and the keel, which we must regard in the light of a necessary accompaniment of these grooves, began to perform a new function. The excavation of the phalangeal notch, its extension into a groove, and the subsequent moulding of the metapodial surface into a secondary keel to fit the groove were just as much a mechanical necessity as was the original or primary formation of the lateral grooves and keel. The proof of this is to be found in the fact that in the further extension of the keel beyond the digitigrade stage, the phalangeal groove led the way. In the mechanical explanation therefore, we have every condition satisfied, while upon the theory of natural selection of favorable variations the explanation is vague, unsatisfactory and not in accord with the facts.

American Museum of Natural History, March 29th, 1893.

AMONG THE CLIFF-DWELLERS.

By Clement L. Webster.

In the *August* number of the *Naturalist*, for 1891, the writer in an article entitled "*Preliminary Notes on the Archeology of southwestern New Mexico,*" alluded to, for the first time, the most important discovery of a Cliff-dweller Mummy, made by him in a Cliff-dwelling of that region; and promised to, later on, give a more detailed account of the discovery.

The present sketch then may be considered as a partial redemption of the promise then made.

The Mogollon Mountains of southwestern New Mexico, are one of the most rugged and broken of the great Rocky Mountain system.

This region abounds in deep and vast cañons, sometimes so profound as to almost exclude the light of day. This region is also deeply cut and scored by the channels of the headwaters of the Rio Gila, known as the East, West and Middle branches.

At no other place in this great system of mountains, is there presented so abundant and diversified scenes of wild and romantic beauty.

A strange charm surrounds this region; and there is here presented a remarkably rich field for the study and investigations of the Archeologist.

For almost everywhere here in the natural caves, in, and at the base of the almost innumerable cliffs, are found the former abodes of the Cliff-dwellers. Some of these dwellings are solitary, and only large enough to accommodate one or two persons; while others occupy a series of large connected caves, where are sometimes found as many as twenty-five or thirty beautifully preserved rooms or dwellings. The writer spent some time in this region making explorations in these ancient ruins, sketching and drawing; and here obtained a large and exceedingly valuable collection of specimens.[1]

[1]See report alluded to in the August number of this journal, for 1891.

Extending out from the West branch of the Gila, about three and one half miles above its confluence with the main Gila, is one of the most beautiful, wild and romantic canyons possible to be found.

The average width of this canyon is perhaps thirty-five or forty feet, while towering cliffs rise perpendicularly on either side to a height of from two hundred to three hundred feet by estimate.

Through this wild glen there rushes, during the rainy season, a small stream of pure water, clear as crystal. The lower nearly one-half of these great cliffs is composed of a hard, dark colored basalt, upon which the elements have made but slight impression; and overlying them is a vast stratum of buff colored conglomerate, such as occupies such extensive areas in southwestern New Mexico, portions of Arizona and California.

Here the lower portion of this vast stratum of conglomerate has been worn away by the slow action of the elements, leaving a narrow projecting shelf of basalt extending along horizontally for some distance.

In the base of this conglomerate, nature has formed numerous large connected caves.

These caves the ancient Cliff-dwellers had taken possession of, and in them reared their strange dwellings.

Here may be seen upward of twenty-eight rooms, of different sizes, shapes and designs; which taken together form the most interesting group of these dwelling which the writer has ever seen.

As the object of this paper is mainly to deal with the discovery of the mummy already alluded to, a detailed description of these and other Cliff-dwellings, etc., will be deferred to a future report.

One of the questions regarding the Cliff-dwellers, is that pertaining to the dispositions made of the remains of their dead.

But very few facts have been obtained thus far, which shed much light upon this question.

There have been discoveries made, however, which demon-

PLATE XI.

FIG. 1.

FIG. 2.

Mummied child from a Cliff-dwelling.

strate that in the matter of disposing of the dead, departures from the general custom, whatever that may have been, were occasionally practiced. One of these exceptional cases was brought to light in the discovery of the mummy, which forms the subject of this paper.

This mummy was discovered in one of the rooms of the large collection of Cliff-dwellings just described; and had been carefully placed in an excavation made in the floor, on the side and slightly under the partition wall. The wall here, as well as elsewhere, rested upon the debris which had previously collected in the cave. Every portion of the body, including the nails, hair and teeth, were perfectly preserved.

The preservation of this body was due to the great dryness of the atmosphere of the country, and the chemical elements of the soil, etc., in which it was entombed. The mummy was small, being that of a child apparently about seven years of age; although inferior in size to that of a child of the same age with us.

It had been carefully and completely wrapped in two large pieces of coarsely woven cloth of different textures, made from the fibers of the "Spanish dagger"—which was used so extensively by the Cliff-dwellers for this and other purposes—and then again as carefully wrapped in a large and nicely woven mat of bear grass.

After this, it was bound with cords, onto a small and curiously shaped board of cottonwood; the cords crossing the body and passing through small circular holes made in each corner of the board.

The board had apparently been fashioned with a stone ax, and afterward finished by being rubbed with some instrument.

The hair on the head of the mummy was of a beautiful dark brown color, and of a soft and silky texture. The arms were drawn up near to the sides of the head, and hands clinched; and the legs also were somewhat drawn up.

This description is better illustrated by the plate Figs. 1, and 2, (copied from a photograph) which represent the back and front views of this mummy.

At the feet is shown a portion of the mat which formed the outer covering, and the board to which it was bound.

There existed on the wall of one of the rooms, located a few feet from where the mummy was discovered, many strange and interesting characters, or picture-writings, of these ancient people, painted in the provincial red color.

Close by where the mummy was found, was also discovered an ancient weaving-room, of the greatest interest. In this were found portions of the ancient loom, woven fabrics, etc.

Near the mummy were discovered long braids of human hair identical in all respects with that of the mummy, save that it was much longer and of a coarser texture. In other rooms of this Pueblo, were found great quantities of corn-cobs, husks, and kernels of corn; squash or pumpkin rinds, seeds and stems; gourds, sandals, wearing apparel, basket and other woven work, pottery, stone mills, weapons, utensils, etc., etc. Such a mass of evidence was secured, in connection with the discovery of the mummy, as to leave no doubt as to the genuineness of this relic. So far as the writer is aware, this is the only specimen of its kind of the Cliff-dwellers, ever discovered.

NEW DISCOVERIES OF FOSSIL MAMMALIA OF SOUTHERN PATAGONIA.

By Florentino Ameghino.[1]

I.

At this time, the most important discovery in South American paleontology is the presence of true monkeys in the Eocene of Patagonia. Certain paleontologists have expressed doubts as to the age of the remains. I believe that these doubts have no foundation from whatever point of view one approaches the subject.

From the geological standpoint, the latest researches of my brother, Carlos Ameghino, show that the marine formation, which I have named *Subpatagonian*, and the formation of sub-aerial or terrestrial origin that I have designated *Santacruzian* (the formation which contains the mammals in question), are conformable without a break. The characteristic fossil of Subpatagonian formation is *Ostrea bourgeoisii* (R. de C.). In the east, toward the Atlantic, the lower part of the Santacruzian formation, is found to be intersected with beds of *Ostrea bourgeoisii*, representing the upper part of the Subpatagonian with all the beds of the two formations resting upon each other conformably. In the west, toward the Andes, in the lower reaches of the Rio Sehuen, and in the vicinity of the lakes Viedrua and Saint-Martin, the marine beds of the Subpatagonian formation rest on the Dinosaurian beds of terrestrial origin, contemporary with the North American Laramie (Pehuenche formation); the transition from one formation to the other is almost imperceptible. Throughout this region no mammalian remains have been found in any formation more recent than the Santacruzian. It is then certain that the fossil monkeys belong to this formation. The *Homunculus* specimens have always been found in place, and in the lower Santacruzian beds. It is beyond a doubt that the fossil monkeys belong to the Santacruzian fauna.

[1] From the Revue Scientifique, Jan. 7, 1893.

It remains now to ascertain if the Santacruzian fauna is really Eocene, or if it belongs to a more recent epoch. The affinities of the lower part of this formation with the Dinosaur beds, the presence of Creodonts and Plagiaulacidae, the absence of the modern groups of Ungulates, seem to me to demonstrate plainly that we have to do here with a fauna which dates at least from the commencement of the Tertiary epoch, and which represents the development upon the spot of an autochthonic fauna dating from an anterior geological epoch. Another proof of its antiquity is that a large number of Laramie mammals from the United States described by Marsh, have their nearest allies in the Eocene of Patagonia.

On the other hand, some of the forms characteristic of the Puerco fauna of North America are found in beds much more recent (Lower Oligocene and Upper Eocene) of the Argentine Republic in the neighborhood of Paranà (*Periptychus* Cope). It must also be said that all the authors who have studied the conchological fauna of the rocks of Paranà (d'Orbigny, Darwin, Bravard, Doering, Philippi, etc.), have referred this fauna to the Upper Eocene or to the Lower Oligocene. But, between the Santacruzian fauna and the fossil fauna of the Paranà, there is, when we consider the development of forms, a considerable hiatus, almost an abyss, that can only be filled by the aid of a half-dozen intermediate faunas yet to be discovered. Moreover, the greater part of the types of the Santacruzian fauna, considered from the point of view of an evolutionist, represent forms less advanced than do the totality of similar forms found in other continents.

Thus all the evidences—geological, paleontological and evolutional—are in favor of the great age of the Santacruzian fauna. I place this fauna at the beginning of the Tertiary, and consider it to be contemporary with the fauna of the Puerco of North America. I believe that the more we seek to place this fauna at a later date, the harder it will be to explain the affinities it presents with the faunas of other continents.

Returning now to the fossil monkeys of this formation, I can say that my brother, in his last exploration, found some new specimens, among them, a skeleton, almost complete, of *Ho-*

munculus patagonicus, in the lowest bed of the Santacruzian formation. This skeleton is imbedded in a large block of stone, and, as yet, only a few bones have been exposed. The lower jaw has been taken out almost intact, with its entire dentition. This new specimen, the preservation of which leaves nothing to be desired, shows that the jaw is not so narrow nor so compressed as I have figured recently in drawing from a specimen whose symphysis was evidently distorted by pressure. In the new specimen now at hand, the distance between the internal posterior border and the second true molar on each side is 10 mm., 5. It thus results that the two dental series are more widely separated at the back, and that the whole jaw is much more elevated.

The exact dental formula is I $\frac{2}{2}$, C $\frac{1}{1}$, P M. $\frac{3}{3}$, M $\frac{3}{3}$. The first two true inferior molars are very nearly of the same size, but the third is smaller. The internal incisors are weaker than the external ones. The canine is a little more developed than in the first specimen, and is separated from the premolar by a small diastema. It is probable that the two specimens are respectively male and female. Unfortunately, the individual represented by the new specimen, was very old, so that one can no longer detect the details of the surface of the crown of the molars. The dental series measure, in a straight line, 31 millimeters. The femur is 11 centimeters, and the radius 95 millimeters long. The humerus has a large epitrochlear perforation, but it lacks the intercondylar foramen. Each of these bones, in form, are those of a man in miniature.

Among the other forms belonging to the Santacruzian formation, and which ought to be better known, I will select only the most important, beginning with the Ungulates which are exceedingly interesting.

II.

I have been able to reconstruct the foot of the Mesorhinidæ (the genera Mesorhinus, Theosodon, Pseudocoelosoma), which are the predecessors of the Macraucheniidæ. The genus Theosodon had five toes in front as well as behind; the three in the middle were well-developed, very similar to those of *Macrau-*

chenia, but the internal and external on each foot were very small.

The Homalodontheridæ also had five toes on each foot, but with them all the toes are well-developed. The feet are strong and robust, and it is worthy of note that the hoof-bearing phalanges are split up, and have the same shape as those of the Chalicotherium of Europe. The carpal and tarsal bones have the alternate arrangement. The legs are equally robust, and the humerus has an epitrochlear foramen. The bones of the feet and of the legs bear a singular resemblance to those of the Edentates, but there are also more characters of specialization altogether peculiar, without which they might be taken for the direct ancestors of the Edentates. The Homalodontheridæ are the ancestors of the more modern Chalicotheridæ of the Northern Hemisphere. It is a mistake to look for the stock of the Chalicotheridæ in the Meniscotheridæ. The latter represent a type allied to the Proterotheridæ, with which they ought to have a common ancestor as yet unknown.

The Proterotheridæ present us with peculiarities still more surprising. The discovery of the leg bones of the Thoatherium prove that it was a monodactyl like the horse. Moreover, in the *Thoatherium minusculum,* the reduction of the parts was still more advanced than in the horses; the posterior feet are very slender, provided with a single toe, the third, while the second and the fourth are represented only by vestiges of the metatarsals, much more atrophied than are the same bones in the horse. One sees, in this case, an example of parallel evolution very remarkable. A complete reduction of the bones of the foot among the ungulates has taken place in two different families, at two different epochs, a fact perhaps without precedent in the Vertebrate series.

It is, however, certain that there exists a certain ancestral relation between the Proterotheridæ and the Equidæ, for the latter have descended from a form approaching the Protere-therium, but with complete dentition. I have elsewhere stated that in Europe as in North America, one may be able to trace the genealogy of the horse beyond Anchitherium (Mesohippus included), and that one ought to separate definitely from the

ancestral line of the horses, the genera Palaeotherium and Hyracotherium, as well as the different types of the sub-order of Condylarthra. In my opinion, the horses originate from a group of Litopterna, from which sprang, at the same time, the Paleotheriidæ and the Hyracotheriidæ, and this ancestral type would be closely related to the Proterotheriidæ.

It would seem that I am right, for the splendid monograph of the genus Mesohippus, recently published by M. Scott, shows that the calcaneum of this genus still possessed a very small articular facet for the fibula, the last vestige of the litoptern organization, however, the shape of the astragalus, as a whole, is already like that of a Perissodactyl.

We now have evidence to warrant the statement that the horses are descended from a form allied to the Proterotheridæ, and which ought to differ from it above all by its orbits open behind, and its complete dentition, in a continuous series. This ancestral is, perhaps, the *Notohippus* or a kindred genus, but, be that as it may, it is undoubtedly in the Northern Hemisphere that the group of horses has acquired the characters which distinguish it at the present time.

The genus *Astrapotherium* is now known, not only by a skull almost entire, but by many of the bones of the skeleton. The skull, in its anterior part, agrees in a number of points with those of the Proboscidians, and could have carried a proboscis as fully developed as that of the elephants. The bones of the limbs also greatly resemble those of the elephants, and there is no doubt that this type represents the nearest relative of the Proboscidians discovered up to this time in the older formations. The genus *Astrapotherium* is certainly not the direct ancestor of the Proboscidians, but only a collateral branch of the trunk from which the latter have sprung. However, some of the other genera of the family of the Astrapotheridæ, Astrapodon for example, may well be considered the ancestor of the living Proboscidians.

In any case, the latter have acquired their characters upon some other continent, as it is certain that during the epoch of the formation of the fossiliferous beds of the Paranà, the Proboscidians had no representatives in our country. These ani-

mals did not make their appearance in the Argentine Republic until the end of the Miocene.

The new specimens of fossil rodents taken from the Santacruzian formation afford unexpected opportunities for comparison. The fossil Cercolabinæ of Patagonia are the ancestors of all the hystricomorphous rodents. The Stiromys have, while young, five superior molars on each side, but the next to the last premolar is soon lost. From the primitive Cercolabinæ are derived the Eocardiinæ, the Eryomyinæ, and the Echinomyinæ. The Eocardiinæ, in their turn, have given rise to the Caviidæ and to the Dasyproctinæ. The Octodontidæ, which now seem to be isolated, have come from certain forms of primitive Echinomyinæ. The discovery of complete skulls of the genus Scieromys, enables me to recognize in this genus the true origin of the Octodontidæ. There are still some intermediate forms wanting, but, no doubt, they will be found soon in the fossiliferous formation of the Paranà.

Not only are the Cercolabinæ of the Eocene of Patagonia the primitive source of all the Hystricomorpha, but they are also the ancestors of another group of rodents, the Myomorpha, which seem also, for the present at least, entirely isolated in that order. The origin of the rats is found in the genera Acaremys and Sciamys, from the lower Eocene of Patagonia. The Myomorphs are not derived from the Acaramyinæ, they having lost their premolars and undergone various modifications in the conformation of the skull. If fossil rats have not yet been found in the Paranà beds, it is on account of their fragile bones, but, in all probability, they will be found there some day.

I now know a part of the dentition of the animal that I have named Tidaeus—this name being preoccupied, I substitute for it, Mannodon. The *Mannodon trisulcatus* is the first genus of Plagiaulacidæ of Patagonia which has the inferior molars constructed on the same type as those of the Multituberculata. It is a genus closely related to Neoplagiaulax and Ptilodus.

Many of the types of the Plagiaulacidæ present a feature that is strange to be found among mammals. The Epanorthidæ, for example, have the inferior incisors beveled on their

internal border, and not on their upper face as is the case among rodents and all other known mammals which have chisel-like incisors the mandibular branches of the same animals have no symphyseal suture, the surface of the bone, at this point, being nearly as smooth as the rest of the jaw. It thus results that the two mandibular rami of the Epanorthidæ were susceptible of lateral movements, and the singular incisors could perform, up to a certain point, the function of horizontal pincers.

Also, although I am quite convinced that the Plagiaulacidæ and the allied fossil forms have been derived from the Didelphian Diprotodontia, the relation with the living Diprotodontia is not so close as I had thought. The discovery I made showing that the large furrowed tooth of the mandible of the Plagiaulacidæ is not the last premolar, as had been believed, but is the first true molar, separates the latter from the living Diprotodontidæ. This character justifies a sub-order in the Diprotodontia, to which can be given the name Plagiaulacoidea, a name which is as appropriate for the northern forms known as Multituberculata as it is for those of the Eocene of Patagonia.

The recent studies that I have made of the Microbiotheriidæ have confirmed me in my opinion that they represent the direct ancestors of the living Didelphyidæ. The latter have certainly originated in South America, and although their remains have not yet been found in the Paranà formations, they will be found there some day.

One of the fossil groups of Patagonia which presents the greatest interest is that of the primitive Carnivora, allied both to the Dasyuridæ and to the Creodonts. It seems to me impossible to find a line of demarcation between them. In studying the material in my possession, I arrive at the following conclusions: The Dasyuridæ are descended from the Microbiotheriidæ and are then modified into Creodonts; these, in their turn, are transformed into the more modern Carnivores. The dental formulæ of these primitive carnivora are varied—take, for example, the superior incisors, of which the Microbiotheridæ have five pairs like the Didelphydæ; the Dasyuridæ have

only four pairs, and the same number is found among other forms allied at once to the Dasyuridæ and to the Creodonts. The larger number of the Creodonts have only three pairs, and, in some genera, but two, and even a single pair. There are some specimens in which one can trace the evolution from the primitive formula. Thus, in the genus Amphiproviverra, the internal pair of superior incisors are entirely atrophied and useless, while the other three pairs are well-developed. This proves that it is the internal pair of upper incisors that is lost in the passage from the Dasyurian form to the creodont and carnivorous forms.

Perhaps the most remarkable specimen discovered during the last exploration is a skull almost entire of *Borhyæna tuberata*, an animal which has hitherto been known only by some insignificant fragments. It is certainly one of the most singular carnivores that is known. It must have been rather large since its skull is 205 millimeters long, and nearly 15 centimeters in transverse diameter at the level of the zygomatic arches. The upper arch of the skull is in an almost horizontal plane with the cerebral cavity excessively reduced, but the sagittal crest is very long and well-developed; the frontals have no postorbital apophyses, and the nasals are widened behind in an extraordinary manner; the anterior nasal opening has the characteristic form of placental Carnivora. The lachrymal canals open entirely inside of the orbits. The malar bone is prolonged behind to the glenoid cavity, of whose border it forms a part of the boundary as in the Marsupials. The palate has no palatine foramina. The upper incisors are reduced to two pairs, of which the internal one is atrophied. Between the canine and the external incisor on each side, is a large groove intended to accommodate the lower canine; this groove replaces the deep fossa which is found in the same place in Dasyurus and Amphiproviverra. These grooves and the contraction of the anterior part of the intermaxillary bone, followed by the reduction in the number of the incisors, gives the anterior part of the skull the appearance of a rodent. The canines, premolars, and molars, of each side, form a continuous series. There are seven molars, of which three are premolars

and four are back molars. The first have but a single cusp, but they have a posterior heel, well-developed in the last. The first three true molars increase regularly in size from the first to the third, and have the anterior internal cusp atrophied, which gives them a cutting form, especially noticeable in in the third. The fourth is much reduced, and occupies the same position as in the genera Thylacynus, Prothylacynus and Amphiproviverra. Perhaps Dynamictis, of which only the lower jaw is known, is a synonym for Borhyæna. In any case, the latter animal was a formidable Carnivore, as dangerous as our tigers, and which it is hard to classify. It may belong with the placental Carnivores, or among the marsupial flesh-eaters (Dasyures), or with the ambiguous forms known as Creodonts.

It would take too long to speak of the numerous fossil Edentates of the Santacruzian formation and of the many peculiarities they present. However, I cannot resist mentioning one of the greatest novelties of the new family of the Metopotheriidæ, which comprises the genera Metopotherium, Pelecyodon, and Zamicrus. In this group, each of the horizontal branches of the mandibula is formed of two distinct bony parts, one in front, the other behind. These two pieces are united by a suture which commences at the alveolar border, very nearly in the middle of the dental series, and is directed obliquely back and down, terminating in the lower border, almost just below the last tooth. This is evidently a character inherited from the reptiles. The same suture can be seen, but not quite so plainly, in the mandible of some of the Orthotheriidæ.

I remarked, in the beginning of this article, that I had found some forms characteristic of the Puerco of North America in the beds much more recent than those of the Santacruzian epoch. In fact, I have received from the Paranà, a fragment of a upper maxillary, which shows several tooth sockets and one tooth in place. The latter corresponds to a third premolar. It is impossible to separate this specimen generically from Periptychus (Cope). The tooth resembles perfectly the third upper premolar of *Periptychus rhabdodon* and shows the same grooves or wrinkles in the enamel which

distinguishes the North American species. However, the South American species (*Periptychus argentinus* Amegh.) is easily distinguished by its size—almost a third smaller—and by the insertion of the molar teeth which are closer together, forming a continuous series. This specimen was found in the Lower Oligocene or the Upper Eocene in the neighborhood of Paranà.

While I am speaking of the fossils of that region, I must add that the doubts which I had concerning the real nature of Ribodon are now set at rest. The new material at hand shows that *Ribodon limbatus* belongs to the Sirenia, and is one of the family of Halitheriidæ.

III.

I would like, in closing, to reply to the objections that have been made to my classification of the Tertiary beds of the Argentine Republic, and particularly to the assertion of Professor Steinmann, who maintains that the beds I have designated Miocene and Pliocene are only Plistocene (or Quaternary).

I have not the complete work of Professor Steinmann, and therefore will refer only to the extracts that he has published.[1]

I am more and more convinced that the Pampean formation is tertiary, and not quaternary. The Araucanian, of which Professor Steinmann speaks, is entirely distinct from the Pampean formation. The vast difference which exists between the Paranà fauna and that of Monte-Hermoso is easily explained by taking into account the fact that the first is Lower Oligocene or Upper Eocene of the old geologists, while Monte-Hermoso is Upper Miocene. Some day, when the Lower Miocene of Catamarca (an Araucanian bed) is explored, and the mammalian fauna of that formation is satisfactorily known, the great break that is now held to exist between the fauna of the Paranà and that of Monte-Hermoso will largely disappear.

I am astonished that any one can still speak of a glacial epoch and of traces of glacial action in connection with the Pampean, and still more so in regard to the pre-Pampean formations. The Araucanian bed is formed by the accumu-

[1]American Naturalist, 1891, p. 855.

lations of volcanic detritus. The Pehuelche is of fluviatile origin. Is it necessary to repeat for the hundredth time, that there is not the least vestige of glacial action in the Pampean formation?

It is impossible to name single fossil species from the Pampean formation which is characteristic of a colder climate than now prevails in the same country. On the contrary, not only does the mammalian fauna indicate a warmer climate than at present, but the fresh water conchological fauna also furnishes similar evidence. The many fossil plants of the Pampean formation are the same that are seen to-day in the province of Buenos-Ayres, or in the northern part of the Argentine Republic—not a single form belonging to a cold climate. I am almost certain that an examination of the marine shells of the same formation would lead to the same result. I am about to make a collection of them to send to M. von Jhering, whom I will request to study them from this point of view.

EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—We have had occasion to refer in previous numbers of this journal to the difficulties under which the Geological Survey of Georgia has labored, by reason of the attempts of a political board to assume its direction. This board appears to consist of men ignorant of Geology, and who use the survey as an opportunity for giving places to their friends. The director of the Survey, Dr. J. W. Spencer, has not been permitted to direct, nor even to select his subordinates, so that chaos has been the natural result. Ignoring the fact that this state of affairs has been due to their own incompetency, the board has asked for the resignation of the director of the survey. This Dr. Spencer has very properly refused to furnish. In a letter to the Governor he presents a strong defense, which is an arraignment of the board of a convincing character. It is evident that the board should resign, rather than the director of the Geological Survey. If they will not resign, the board should be abolished. It appears that their misgovernment has not been confined to the Geological Survey, but that many of the educational interests of the State have suffered at their hands. If Governor Northen desires the acquisition of accurate information as to the material resources of Georgia, he can not do better than retain Dr. Spencer in his present position. If he regards the fair fame of Georgia, he will use what power he has to abolish the present board, and when a competent one is selected, it will permit the State Geologist to select his own assistants. That the Governor sees the question in its true light is evident from the fact that he has requested Dr. Spencer to continue his work and complete the report. It is to be hoped that the Governor's course will put an end to the interruptions and difficulties which have beset the survey for too long a time. Should it do so, he will have the warm commendation of the scientific interests of the entire country. Private interests, especially of mining districts, have often interfered with the comfort of honest geologists, as in the case of Professor Branner, of the Arkansas Survey; but their attacks have always resulted in the scientific vindication of the experts whose education and experience have enabled them to reach just conclusions.

—A ridiculous bill has been introduced into the Legislature of Pennsylvania with the following title and provisions, by Representative

Jno. H. Fow, of Philadelphia, "(No. 163) An Act to prohibit public exhibitions of physical or mental deformities in certain public places."

"SECTION 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same, that on and after the passage of this act, it shall be unlawful for any person to exhibit in any public hall, museum, theater or any other building, tent, booth, or public place, for a pecuniary consideration or reward, any insane, idiotic or deformed person or any imbecile, and whoever shall exhibit such mental or physical deformity, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be sentenced to pay a fine not exceeding one thousand dollars, or suffer imprisonment not exceeding six months or both, or either at the discretion of the Court."

If this bill becomes a law, it will require the closing of scientific exhibitions of abnormalities to students where a fee is charged, as well as the more popular exhibitions of a miscellaneous character. It will thus deprive the public of a real source of instruction, which is important from various points of view. It will deprive scientific men of the opportunity of examining many curious pathological specimens which the industry of the exhibitors brings together, and which would be otherwise generally inaccessible to them. The Alexis St. Martins, Siamese Twins, double monsters and other such specimens, which are most important for physiologic research, would no longer come to Philadelphia. It will also deprive many unfortunate persons of making a very good livelihood, who would otherwise become chargeable to their relatives or to the State. What good is to be attained by the passage of such a bill it is impossible to imagine.

—THE New York game protector, Mr. Willett Kidd, and the *Forest and Stream* periodical, are to be congratulated on the successful result of their endeavors to enforce the game protection law of the State against the restaurateur Delmonico, of New York City. For having in his possession eighteen woodcock killed out of season, Delmonico has been compelled to pay a fine of $25 apiece—total, $450.00. This result was only attained after persevering efforts, prolonged through many months. The delay was due to the culpable neglect of Prosecuting-Attorney Nicholl, of New York, who would have permitted the culprit to escape, had it not been for the interest of Judge McCarthy, who took up the case himself. We trust that the game and fish laws of all the States may be enforced as effectually, and a great deal more promptly.

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RECENT LITERATURE.

A Summary Description of the Geology of Pennsylvania. Vols. I and II.[1]—The results of the Geological Survey of Pennsylvania from its beginning, in June, 1874, to the close of its field work, June 1, 1890, have been summarized by Professor J. P. Lesley, in three octavo volumes of 700 to 800 pages each, of which Vols. I and II have just been issued, while Vol. III is promised in June, 1893. This summary is compiled from the reports published by the Board since 1875, with the corrections, and the additions that the accumulation of fresh facts make necessary. Vol. I describes the most ancient deposits: The Laurentian granites, gneisses and mica schists; the Cambrian gneisses, schists and limestones; the lower Silurian limestones and iron ores, roofing slates and mountain sandrocks; Formations II, III and IV, in the order of advancing time and superposition. The second volume describes the Upper Silurian red shales, limestones, and fossil iron-ore beds; the glass sand-quarry rocks; the black and gray shales, and the gray and red sandstones, with fish beds; Formations V, VI, VII, VIII and IX reaching to the top of the Catskill Mountain rocks, the upper limit of the Devonian system.

Each formation is discussed in detail. Its geographical distribution, thickness, lithological characters and fossil contents are carefully described, together with its relation to similar formations of neighboring states.

The question of sedimentary Archean rocks receives attention, and while discussing Archean rocks in general, Professor Lesley calls attention to the fact that the Huronian rocks of Canada are nowhere recognized along the Highland Belt from the Hudson to the Schuylkill. In the author's opinion, the term Huronian, "must be used simply as a proper and private name for a series of rocks exposed along that part of the northern boundary of the United States." In the paleozoic series, Professor Lesley does not clearly discriminate between the Cambrian and Ordovician limestones, including them all under the one head of No. II, as was done by the first geological survey. He leans toward the explanation given by Dr. Fraser of the structure of the Chester Valley, rather than those of Hall and Rogers.

The illustrations are numerous, many of them being photo-electro-

[1] A Summary Description of the Geology of Pennsylvania. Final Report ordered by Legislature, 1891. Vols. I and II. By J. P. Lesley, Director, Harrisburg, 1892.

type reductions of the drawings made by the assistant geologists. Page plates of fossils accompany the chapters of the several formations. These are half-sized reproductions of the figures of fossils given in Report P. 4, Dictionary of the Fossils of Pennsylvania and the surrounding States, published in 1889–1890.

The present report has been evidently written with an eye to the general rather than the scientific public. As a popular synopsis of the geology of Pennsylvania, it will have much utility. As a discussion of the more abstruse problems presented by the structure of the formations of the State, especially of the eastern region, it has less value.

The Earth's History,[2] by R. D. Roberts, is an attempt "to furnish a sketch of the methods and chief results of geological enquiry, such as a reader interested in the subject for its own sake would desire to obtain. It is not intended to be a text-book of Geology." Beginning with a brief history of geological thought, it takes up the earth-history and shows how geologists are enabled to trace the successive steps in the development of the earth's physiography, by reference to the records of the rocks as interpreted by means of the results of investigations into the processes at present active on and beneath its surface.

The central idea of the author is "to reconstruct, from ancient fragmentary remains, the old conditions that characterized the successive stages in the evolution of the land areas; to make out the life-history of the earth," and this idea has determined the method of treatment of the subject matter. The book is not crowded with geological facts, it is not a dry abridgment of some popular manual of geology, but it is exactly what its author intended it should be—an exposition of geological logic. Its style is simple and clear, its statements are accurate, and its various parts are well proportioned. In short, it is an excellent volume for collateral reading for college classes in geology, and a fine introduction to the geological methods for general students.—W. T. B.

Wright's Light,[3] although mainly a discussion of light phenomena that may be projected upon the screen by means of a lantern with the lime light, is nevertheless, an excellent volume for study by

[2] The Earth's History, an Introduction to Modern Geology, by R. D. Roberts, University Extension Manual. New York: Scribner's Sons, 1893, pp. 270, Pl. ix. Price, $1.50.

[3] Light, a course of Experimental Optics, chiefly with the Lantern. By Lewis Wright; 2d Ed. Macmillan & Co., pp. 391, Pl. 9, Figs. 207. Price, $3.25.

the students in the theory of light—natural and polarized. The value of the work to the student of polarized light lies in the fact that many experiments are described that aid one to gain a clear notion of double-refraction, of interference, and of the resolution of vibrations into two sets at right angles to each other, without compelling him to accept the conclusions of mathematical processes. Scattered between chapters dealing with the experimental data are others, in which these data are explained, and a few in which the theory of light vibrations is discussed, the whole forming a logical exposition of the modern theory of light.

Unfortunately for the reader, there are many clumsily-constructed sentences in nearly every chapter of the book, which need much close study before the meaning of their author can be discerned. This fact necessarily detracts from the delight with which the volume would otherwise be perused, but not so much so as would be the case were it not so compactly written. An immense amount of material is collected within its covers, and very little of this matter could well be spared by the student. A little more confidence might have been felt in the author's statements, as representative of the most modern views of light specialists, had he given some evidence of his acquaintance with the wonderful grating of Rutherford and Rowland, instead of mentioning only Noblet's gratings and Barton's buttons in his discussion in diffraction. The imperfections, however, are slight as compared with the abundant good qualities of the book.

The volume is well printed and splendidly illustrated with a wealth of cuts and nine lithographic plates, of which four are beautifully colored.

The student of light phenomena will find many of his difficulties in understanding the theory of his subject cleared away if he will carefully examine the experiments described by Mr. Wright, and thoroughly digest the accompanying explanations.—W. T. B.

General Notes.

GEOGRAPHY AND TRAVELS.

Africa.—Ibea, or British East Africa.—Although the continent of Africa is now gay with the colors which distinguish the spheres of influence of the various European countries, and though it has now been crossed and re-crossed in almost every conceivable direction, there are still considerable areas about which very little is known. This is especially true of the regions adjoining and intervening between the great lakes of the Equator; those vast fresh-water areas dimly known to the ancients, but entirely lost to the moderns until the present generation. The politico-religious troubles in Uganda, which some endeavored to convert into reasons for the abandonment of that country by the British, have directed considerable attention toward that region, and Captain Lugard, whose name has been prominent in the recent troubles, has not been slow to furnish information. The British sphere of influence in this quarter is separated on the north from the Italian by the river Juba, while to the southwest a line drawn from the center of the east shore of Victoria Nyanza, to a point on the ocean near the island of Penba marks the edge of the German sphere. This line is however, bent northward around Kilima njaro, so that the whole of that snow-clad elevation is within the German sphere. At the Victoria Nyanza the Anglo-German boundary is deflected westward. Upon the west, the British protectorate is bounded by the Congo State. The territory of Uganda stretches along the north and northwest shores of the great lake, extending inland as far as Unyoro, which skirts to the southeast shores of the Albert Nyanza; eastward of Uganda toward the Albert-Edward Nyanza, lies the district of Ankoli. The whole of the British sphere in northeast Africa has received the name of "Ibea," formed from the initials of Imp. British East Africa Co., and, as this name is both short and pretty, it may be hoped that it will persist when the company itself is a thing of the past.

Captain Lugard's route to Uganda was from Mombasa to the little river Sabaki, to the south of Mount Kenia, which is entirely within the British sphere. According to him, the source from which the great Victoria Nyanza derives its supply of water is among the chief

geographical puzzles of Africa. All the rivers flowing into the lake are very small, and the broad Somerset Nile which flows out of its northern coast certainly carries away more than is received by their combined streams.

The greater part of the waters which fall upon the Uganda region seem to make their way either to Lake Rudolf or Lake Baringo, and we must therefore assume that Victoria Nyanza is fed by springs. The western shore of Lake Albert is faced by a lofty plateau, the waters of which flow, not to the Nile basin, but to the Ituri, a tributary of the Congo. The Senliki River, which, under various names, unites the Albert-Edward or Mwutanzige Lake with the Albert Nyanza, is relatively small where it issues from the former, and its considerable volume at its entrance into the latter is due to the affluents which flow from the western extremity of the snow-capped range of Ruwenzori. Though the eastern portion of this range drains directly into the Mwutanzige, the waters flowing from the western part are sufficient to convert the lower portion of the Senliki into a deep and rapid river. Adjoining the Victoria Nyanza on the northeast is the fertile district of Kavironda, where much grain is grown and where the natives, a good-natured and merry set, wear no clothing of any kind unless the tusks of wart-hog, horns and wings with which the warriors decorate their heads can be considered as clothing. Passing west from Kavirondo to Usoga, a district tributary to the Waganda, the character of the agriculture suddenly changes, the grain giving place to bananas, potatoes and cassava, though no marked difference of soil or aspect can be detected in the surface of the country. Moreover, the transit is from nudity to clothing, for every native of Usoga, like the Waganda, is dressed in the mbugu, an ample garment manufactured from fig-bark. The dress of both sexes is the same, but while the mbugu of Usoga is black, that of Uganda is brick-red. East of Kavirondo is an equatorial plateau seven to eight thousand feet above the sea, apparently well-suited for the residence of Europeans, and gradually sloping to the Kavirondo lowlands. In various parts of this plateau are still to be found remnants of the once powerful nation of the Gallas whose forces have been exhausted in the struggle with the Masai to the south and the Somals to the north. A curious feature of the districts of Uganda and Unyoro, according to Captain Lugard, is the scarcity of running water, and the occurrence of swamps in every depression. The average elevation of Uganda is 3,700 feet, while Unyoro, though not greatly dissimilar in general aspect is higher, and has loftier hills. The Waganda possess great natural aptitude, are clever carpenters

and smiths, and can be readily taught European methods of working. They are fond of music, have many rude musical instruments, and possess a currency of cowries. Mentally, they are certainly superior to the surrounding races. Uganda is divided into ten provinces, each of which has its chief, while over all is set a vizir. The system of land-tenure is very complex, and chieftainships are complicated. The northern part of Ankoli is thickly peopled, but the land has suffered terribly from the cattle-plague, which has reduced all the pastoral tribes of this region to a state bordering on starvation. Not only have millions of domestic cattle fallen before this dread disease, but the buffalo has been practically exterminated, while the eland and the smaller kinds of antelopes have suffered severely.

The Albert-Edward or Mwutanzige is really a double lake, for the long northeastern arm known as Ruvango is only connected with the larger body by a river not more than 500 yards across. This lake is abundantly supplied; the Mpanga alone brings down more water from Ruwenzori than is taken out by the Senliki.

During his circuit from the Victoria by the Albert-Edward to the Albert Nyanza and Wadelai, Captain Lugard picked up the Sudanese refugees left by Emin Pasha, and upon his return was accompanied by some 9000 people. He concluded his address before the Royal Geographical Society with a graphic picture of the present disordered state of the countries west and north of the Uganda, smitten by the cattle-plague, oppressed by a usurper named Kabarega, and only prevented from freely accepting protection, from the fear that all protectors, like Stanley, will depart and thus leave them a helpless prey to the vengeance of their oppressors.

Uganda is a region of rounded grass-clad knolls, while Unyoro is more rugged, often with fantastic piles of granite, and abounds in caves. The rivers of Uganda are large papyrus swamps with no current, and little open water. The hills are of red marl or shaly gravel. In past times Uganda had broad roads, often with culverts across water, and even now it would be easy to make a good road to the Albert Nyanza. More grain is grown in Unyoro than in Unganda. A survey for a projected railway from the coast to Victoria Nyanza has already been made for 350 miles.

There seem to be several small lakes in Buddu, a province of Uganda west of the Victoria Nyanza; in Koki, a tributary state east of Buddu, and in Ankoli, the eastern part of which has loftier hills and poorer soil than Buddu. One of these lakes, between Ankoli and Koki, is named Kashera. Iron seems to be abundant in these

districts. The natives of Ankoli are Wahuma, a fine race apparently with affinities to the Galla and Somali, but mingled with Bantu.

The Tana, a large river south of the Juba, has been navigated by Captain E. G. Dundas in the stern-wheel steamer *Kenia*, to within a short distance of the mountain of that name, which was afterward ascended to a height of 8,700 feet. The Tana has two mouths, the northern one, the Ozi, is not now important, but the entire district between it and the Tana mouth is alluvial. The lower portion of the river is almost meridianal, but close to the equator a broad westerly curve conducts to the congeries of affluents which descend from the forest covered slopes west of Mt. Kenia. The steamer could proceed as far as Hameyé, near the equator, at the start of the great bend. The peoples met with in the ascent were the Kalindi at the mouth, the Ngao, Omoina, Ndera, Guano, Ndura, Sabaki, Malululu, Malakote, Wasania, Korokoro, Wandorotu, Murdoi, Wathaka, Mumomi, Mbe, Kikoya and Muea near Mt. Kenia.

The smaller Sabaki river to the south of the Tana, also has its headwaters in the forest belt S. W. of Kenia. The existence of such a river as the Tana, navigable through more than three degrees of latitude, was until recently pratically unknown. A considerable fall about 18° south of the equator, and sixty feet high, terminates the navigable part of the stream.

It may be remembered that Mt. Kenia has been ascended by Count Teleki to a height of 15,350 feet, yet he estimated that there was still above him 3,500 feet to the highest summit. The forest reaches to 3,500 feet, bamboos to 10,500, after which the vegetation as far as the snow-line at 15,000 feet consists of mosses and the curious tree *Senecio johnstonii*. The slope toward the west is very gentle, but southward the mountain presents a serrated ridge four miles in length.

An expedition has started for the Juba River commanded by Lieutenant C. R. Villiers, and accompanied by J. W. Gregory of the British Museum.

Asia.—A Visit to Peik-Tu-Shan.—Mr. Carles has recently paid a visit to the singular white-topped and flat-topped mountain in Mantchuria, from which issue the sources of the three great rivers Tumen, Yalu and Sungari. This mountain, which has upon its summit a lake some twelve miles in circuit, at an elevation of 7,500 feet, had been previously been visited by Mr. Younghusband and his party, but Mr. Carles was moved to undertake the journey from Seul, the capital of Korea, by reading an account of it in a Chinese work.

This account, exaggerated though it was, giving to the mountain a height of five miles, and to the lake a proportionately expanded circumference, showed that there really existed a remarkable elevation. Chan-y-Peik, the "Ever White Mountain," is well-wooded to the top, and thus presents a contrast to the isolated Peik-tu-Shan or Old White Mountain the summit of which is bare, and white with pumice. It is the latter which encloses the lake.

The account of the journey, in the March issue of the Proceedings Royal Geological Society is full of interesting matter concerning the ways of the large-hatted Koreans, their threshing-floors of beaten clay, the pickled cabbages and turnips so dear to their palates, their dress and domestic animals, among which the black and hairy pig is conspicuous. The untidiness of a Korean village offers a marked contrast to the neatness of a Japanese one, but Mr. Carles gives the Korean rustics credit for a more thorough appreciation of natural beauty than is possessed by any other people. A Korean who has climbed a summit stops, not to complain of the toil, but to admire the landscape. Ham-Heung, the chief town of N. E. Korea, is a walled town with twenty-five to thirty thousand inhabitants.

The Kachins and the Irawadi.—The recent expedition of the Indian Government among the hills of the rebellious Kachins, Chingpaws, or Singphos, who occupy much of northern Burma, toward the Chinese frontier, though they have added to our geographical knowledge of the upper waters of the Irawadi, have not solved the mystery of the Salwin. The upper Irawadi divides into two principal streams, the Mali Kha to the west, and the more easterly Nmai Kha. The course of the former has been mapped as a result of the Kachin expeditions, but little is really known of the latter, save that at its junction with the Mali Kha it is somewhat the larger.

The Kachins seem to be descended from the Karengs, and have for ages been subject to hereditary chiefs or Sawbwas; but of late years many villages have rebelled against these, driven them out or killed them, and these villages are now only governed by 'headmen' with little authority. This, together with the fact that the peaceful trading villages of the Shans and Chinese are each under the protection of a Kachin village, made it difficult to reduce the tribes to subjection. Among the Kachin tribes are the Kanong, Passu, Nankmong, Kamans and Khangs, these are said to be the wildest, and to be unclothed. The district is not one of lofty mountains, but of rugged hills two to three thousand feet in height, intersected by well-watered valleys. A

good deal of opium is grown, but not enough to fully supply this opium-consuming race. No reliable information can be obtained respecting the head-waters of the Nmai Kha. It is thought that the Phung Mai, east of Kanti and the Nmai Kha, may be the latter, while the Lu is the Salwin. All the water that falls upon the land up to within a few miles of the Lu drains to the Irawadi, which thus rapidly develops into a noble river, though it is doubtful whether any of its sources are farther north than 28° 30′.

East Asia Minor.—In these days of exploration of the unknown, some of the districts that have been longest known, and which fill large pages of the world's history, seem to be least visited. It is this which lends additional interest to D. G. Hogarth's account of his travels in Asia Minor—that land of many peoples and of many ruins which has for centuries been the stronghold of the Turkish power. Mr. Hogarth not only examined many ruined cities, but penetrated through several little known passes of the Taurus and Anti-Taurus. In the district between Lakes Egerdir and Beysheher there are no passes, but the Eurymedon cuts its way through a great gorge, and the population interests from its primitive and apparently indigenous character. The Pisidian city of Adada, now Kara Bavlo, perched high on its hill-top, is a most perfect specimen of an Anatolian city of Roman times. Not very distant are the ruins of Lystra and Derbe.

In a small island upon Lake Egerdir are the remnants of a small colony of Greeks, who in the twelfth century deliberately preferred Mohammedan to Byzantine rulers. The monastery of Koja Kalessi is a remarkable ruin, containing a church of the fourth or fifth century, restored in the reign of Justinian, and evidencing the power still possessed by heathen traditions in the entire absence of Christian symbolism from its sculpture. The city of Coropissus is a veritable Pompeii, the church probably of the seventh or eighth century, most of the ruins a little later. The east Taurus is richly wooded, and is traversed by the tremendous canyons of Samanti, Saros and Jihan, not passable even on foot. Several important passes occur farther east than the famous Cilician Gates. This district was the last refuge of the independent Armenians of Cilicia, and their robber towns, Hadjin and Zeitun, still exist. The half-troglodyte Kurds, nominally Mussulmans, but with pre-Mussulman customs, have penetrated to these parts. The Anti-Taurus, deserted since the eleventh century, is now inhabited only by the nomad Avshar and some Kurds, who found their way there about fifty years ago. The great Roman road to the Euphrates can

still be easily traced in the valley of the Saros, and has many milestones. Tne fortified tower of Maidan dates from the first or second century, when the Cilicians were lords of the Mediterranean. Among so-called Hittite monuments, one of the most important is the obelisk at Albistan. This the inhabitants refused to sell to some Germans, the Government heard of it, and took possession without payment. It has sixty-seven lines of inscription on all four sides.

NORTHEAST SIBERIA.—The region of the Verkhoyansk and Stanovoi Mounts, in N. E. Asia, with the upper basins of the Kolyma, Indigirka and Lena, have been recently explored by M. Cherski. Proceeding up the Chandyga River, Cherski reached the heart of the Verkhoyansk, whose summits are below the snow-line. Then by way of the river Dyba, a tributary of the Tyra, he reached the valley of the Omekon, which stream the natives regard as the true head-waters of the Indigirka. The Uchagei-urach does not, as shown on the maps, empty into the Omekon. The Verkhoyansk was then crossed at its junction with the Stanovoi range, where the latter runs eastward. The region between the Indigirka and the Kolyma, covered by the bend of Stanovoi, is split into several subdivides, of which the expedition crossed three, and found the third to be the water parting between the Indigirka and Kolyma basins, the Moma flowing from one side, the Syrjanka, an affluent of the Kolyma, from the other. The valleys of this district are broad with gentle slopes, and without terraces, which are destroyed by the shifting courses of the rivers, the tendency of the latter being rather to fill up the valleys with rubbish than to deepen them. On the southern slopes magnificent poplars and willows flourish, and the meadows have a rich flora. Notwithstanding the high latitude, the temperature in June and July rose to 113 in the sun, though for fourteen days in August it sank below 32. The great longitudinal valleys seem to have possessed immense glaciers in the plistocene period; while the mountains are formed of Silurian and Jurassic folds.

ASIATIC NOTES.—The recent expedition of Lieutenant H. S. Walker, from Napeh in Upper Burma to Arakan, possesses considerable interest, were it only for the visit paid to Myohaung, the ancient capital of Arakan, now peopled only by some 2500 souls. The ancient magnificence of the place is attested by the great ruined walls, forming three squares one within the other, and by two gigantic pagodas, one

with eighty, and the other with ninety thousand images. This city was known to Ptolemy, who speaks of it as Triglyphon.

The outward route was through the An Pass, while the return route was eighty miles to the north. The former was found far the better for a railway, though beyond Dalet it was cut up by creeks, many of which, however, could be missed by hugging Myaintaung Hill. Lieutenant Walker speaks of the Arakanese as indolent and cowardly beyond measure.

W. M. Conway, with a party, started in February of the past year to explore the glacier regions of Baltistan and Karakoram, southeast of Pamir. News of his expedition has several times been received, but no full account has yet been given. He has been the first European to cross the Nashik pass; has explored the Hispar Glacier, a vast level sea of snow of 300 square miles, surrounded by a ring of giant peaks—the largest glacier outside of the polar circle; has ascended many lofty peaks, among which is one which he has named Pioneer Peak (over 23,000 feet) because it was found to precede the Golden Throne, some 2000 feet higher still.

A new map of Persia, compiled from a great number of general and divisional maps, may be found in the issue of the Proceedings Royal Geographical Society for February, 1892. It is on a scale of 600 miles to the inch, and includes Afghanistan and Beluchistan. The boundaries of the famous Persian desert, the Dasht-i-Kavir, with its two large salt-swamps, and the Kuh-i-Gugird, are clearly shown. The desert is shaped like a dumb-bell, and the largest salt-swamp is in the centre of the western portion.

Captain Bower and Dr. Thorold left Leh in June last year, crossed the widest part of Tibet, and passed a chain of salt-lakes, one of which, Bor-Ba-Tu, is probably the highest lake in the world, since it is situated 17,930 feet above sea-level. Their course lay from Ladak to Chiamdo, about 150 miles to the north of the route of Pundit Nain Singh. Though ordered back by the Tibetan authorities, they made their way through Tibet to west China.

Burma and Assam seem temptingly close upon the map, and are only separated by about a hundred miles of hill country, yet a satisfactory road from one to the other has not yet been found. The highest hills or mountains of the district range from but four to eight

thousand feet, but as they are clothed with dense forest and impenetrable jungle, with few inhabited or cultivated spots, the passage is very difficult. The political officer of Assam, Mr. Needham, after having had experience of one route, tried that by which in past times the Burmese armies used to find their way to conquer Assam. This leads across the Patkoi, among hills below 3000 feet in height, to Nongyong Lake, and then via the Loglai to the Singpho village of Ham Yung, thence to Ningbu, three short marches from Maingkhwan.

Australasia.—Australian Exploration.—The news of Australian exploration is always tame and little varied, like the aspect of that "scrubby" interior. Dr. Lindsay and party crossed the space between the courses of Forrest and of Giles. They found the Queen Victoria spring on the latter course nearly dry, and the country seemed to have had no rain for two years. Various bushes were found, also a gum-tree forest which extended into S. Australia. From the roots of certain mallee trees, which the natives know by experience, they procure a quantity of pure water.

In South Australia the country between lakes Eyre and Amadeus has been explored, and seems to be rather more varied than most of the interior, as several ranges of hills, the Musgrave, Everard, Mann, etc., have been found, rising four to five thousand feet above the sea. The Musgrave hills are of red granite, which appears to predominate in the other ranges. Spinifex, a few pines, stunted gums and mulga, are the prevalent trees, but between the Musgrave and Mann ranges is a growth of large casuarinas.

In West Australia the country between Northam and Eucla has been traversed, and good ground has been found in a slightly undulating country. After the limestone was reached (31°, 10′ S., 124°, 30′ E.) the open forest and plains changed to grass and salt-bush plains, well adapted for pastoral purposes. Many holes were met with, probably leading to underground streams. The soil is mostly rich red loam, there are springs in many places, and water is near to the surface. White gum and gimlet-wood were the most conspicuous trees. The land seems rich in minerals. The natives seen were of much finer physique than those which frequent the towns.

New Guinea.—Sir W. Macgregor continues his work of visiting the various tribes of British New Guinea with the aim of bringing them to acquiesce in the government and laws of Great Britain. Great progress has already been made in this matter, so that already some

villages which were built upon piles for security are now removed to dry land. The want of recognized hereditary chiefs among the natives present causes some difficulty, but the coast tribes have to a great extent accepted the change, and the inland tribes, who were for the most part driven inland by the coast residents, are commencing to come in. The area of the British portion is 86,000 square miles, and the population is probably 350,000. On their part the Germans are doing similar work. Between Pouro and Milne bays there is a ridge of lava and coral limestone, rising to 850 feet. The close relationship often supposed to exist between the flora of New Guinea and that of Australia seems scarcely borne out by the facts. Though Proteaceæ and Myrtaceæ abound in the savannahs of Fly River, yet the palms are numerous in species, and at least fifty indigenous plants are known.

Sir W. Macgregor has been specially engaged among the D'Entrecasteaux and Trobriand Islands. The latter are a little known group of small islets, with one language, and a population of some 15,000.

The most interesting discovery has been that of a number of atolls which have, since their formation, been elevated by a horizontal uplift. Kitava or Nowan has a surface of 5.6 square miles, and is now girt by a fringing reef: almost its whole circuit is surrounded by a low sloping margin about a quarter of a mile wide, covered with trees. This abuts against a steep coral wall three to four hundred feet in height, also covered with forest. Within this wall the land dips gently to a plateau fifty to a hundred feet below the edge of the wall, plainly the ancient lagoon. The soil in this interior plain is of a rich chocolate tint, and very fertile. All the natives reside in this protected area, which is drained by filtration through the porous coral rock. Kwaiwata is similar, but much smaller. Gawa is a still more perfect specimen, having a coral wall four hundred feet high, and so steep that it must be climbed by ladders, while the interior is a 100 feet lower. On approaching these islands from the sea they seem to be uninhabited, since the natives live in the saucer-like hollow. In Iwa the raised border has been worn away. A great portion of the south of Fergusson Island, one of the D'Entrecasteaux group, is occupied by the mountain mass of Edagwaba, 4-5000 feet high, composed of mica schist, and in the N. W. corner Kubioia rises to 3–4000 feet. The islets of Namu and Bagiagia are of coral, low and uninhabited. On each of the small Trobriand Islands there is a single village.

Polar Regions.—The Danish Expedition.—Lieutenant Ryder of the Danish navy, contrived in spite of the floating ice which extended from three hundred to three hundred and fifty miles from Greenland, to enter Scoresby Sound last year, and to discover that it was really an extensive fjord with several branches. Hurry's Inlet, a branch toward the north, proved to be a fjord 28 miles long, with gneissic cliffs 3000 feet in height on the east, and westward the crags of Jameson's Land, 2500 feet high, seemingly composed largely of glacial moraine. Many Jurassic and Tertiary fossils were found on Jameson's Land, while at Cape Brewster, where the cliffs rose only from 300 to 500 feet, fossils of older date were found.

The southern shore of Scoresby Sound presents a lofty and unbroken granite wall sixty miles in length, the ground rising in the interior to 3000 feet. The widest inlet is named Hall's Inlet, and trends northwest. On its shores are *roches moutonnées* and striæ in abundance, but no ice. The inland ice is not met with until a distance of 176 miles from the sea is reached, it is found at the heads of the smaller bays and fjords, and all the fjords seem to reach it. The gneiss rises to 500 feet in the southwest, to 3000 in Milne's Land (west of Hall's Inlet) and to 6000 feet in the northern region explored—on the west it is covered with basalt. Animal life proved to be rich, especially on Jameson's Land, where reindeer occurred in wonderful numbers, while the musk-ox was found on Hurry's Inlet. No less than 150 species of flowering plants were gathered. No inhabitants were met with, but winter houses and graves were seen.

Polar Notes.—Several whalers have left Dundee for the Antarctic, in the hope of combining discovery with a good catch.

Dr. Drygalski, in connection with the Geographical Society of Berlin, has erected an observatory between the Great and Little Karajak glaciers, on Umanak Fjord, West Greenland.

Coal has been discovered in Spitzbergen by L. Cremer.

GEOLOGY AND PALEONTOLOGY.

The Western Lowland of Ecuador.—A paper by Dr. Th. Wolf, read at the Berlin Geographical Society, Dec. 3, 1892, gives the following account of the Western Lowland of Ecuador:—

Its superficial area is 25,950 square miles. As late as the end of the Neocene period the waves of the ocean washed the foot of the Western Cordillera of Ecuador. At the commencement of the Plistocene period a part of the northern half of the lowland appeared above the ocean while the southern half was covered over by an immense sandstone formation. The latter, containing here and there the bones of mastodons and horses, was, at a very recent period, subjected to upheaval, which gave to the country very nearly its present configuration.

The great low-lying plain east and west of the Gulf of Guayaquil as well as the smaller alluvial plains, are quite recent formations, true deltas. The highest points of the coast ridge attain an elevation of 2,300 feet in a chalk range between Guayaquil and the sea, and in the Cordillera of Chongon and Colonche. In the Neocene region there are summits of from 650 to 1000 feet. The Plistocene marine strata form a gently undulating country rising from 65 to 260 feet above sea-level, while the extensive plain of alluvium is quite level. The rivers which issue from the Western Cordillera, do not flow due west; but, in consequence of the chalk range which runs north and south, form two extensive river systems, Rio Guayas emptying into the Gulf of Guayaquil, and Rio Esmeralda, flowing without a delta into the sea at 1° N. latitude. (Geog. Journ. Feb., 1893).

Devonian Fossils from Manitoba.—During the summer season of 1888 and 1889, Mr. J. B. Tyrrell made a collection of the fossils of the Devonian rocks of the islands, shores and immediate vicinity of Lakes Manitoba and Winnipegosis. This collection forms the subject of a report by Mr. J. F. Whiteaves, published by the Geological Survey of Canada. According to the author, this collection is one of the most important that have been brought back by the Survey collectors for many years. The species represented are of unusual interest, not only on account of the number of new forms, but also as showing the close relations that exist, in so many respects, between the fauna of these rocks and that of the Devonian rocks of Europe.

Mr. Whiteaves' report comprises 105 pages of text illustrated by 15 full page plates. The classification followed, with few exceptions, is that adopted by Dr. Karl Zittel in his Handbuch der Paleontologie. (Contributions to Canadian Paleontology. Vol. I, Pt. IV, 1892).

Jura and Trias in Taylorville, California.—Professor Hyatt gives the following preliminary results of an examination of four different collections of intervebrate fossils from the Jura and Trias of the Taylorville region in California.

A general comparison of the Trias of Taylorville with that of Idaho and of the Star Peak range in the Humboldt region, Nevada, shows that the Idaho Trias has a well marked Triassic fauna, with fossil cephalopods recognized in Europe by Mojsisovics, Steinmann and Karpinsky, as belonging to the lower part of the Triassic system. This fauna appears to be more nearly the equivalent of that of the Werferner beds of the middle Buntersandstein of the German Trias than of any other.

The Trias of the Star Peak range contains an unmistakably younger fauna. The species show a parallelism with the Muschelkalk instead of the Saint Cassian stage, as has been supposed.

The Trias of Taylorville is quite as interesting as that of the other two localities, and it is suggestive that its age, as indicated by the fossils, is that of the Noric and Karnic series in the upper Trias.

The Lower, Middle and Upper Jura, are represented by characteristic fossils which can be closely compared with representative European species. No remarkable or entirely new types occur, such as have been found among the vertebrata of this continent.

On comparing the Taylorville with that of Aurora, Wyoming, and of the Black Hills, it is found that the latter were deposited in the same basin, the species being largely identical, and that they can be spoken of together as having characteristice of the fauna of the Callovian or Oxfordian in the upper Jura of Europe.

The supposed Callovian of Mount Jura has no species in common with those of Aurora or the Black Hills. This accords with the distinct fauna of the Bicknell sandstone and the Hinchman Tuff, and would go to show that there was no direct connection between the upper Jurassic faunas of the Rocky Mountain region.

The Oolite of the Rocky Mountain region is too little known to permit comparison. Dr. White has described a few fossils found by Dr. Peale near the lower cañon of the Yellowstone in Montana.

The lower Lias, having certain forms of undeniably European facies, occurs in western and southwestern Nevada, and perhaps in California east of the crests of the Sierra. These faunas are older than those found at Mount Jura.

It is obvious that the Jura occurs in widely separated patches, and that, so far as now known, Mount Jura exhibits a larger number of fragments of the series of the Jurassic system than any other locality in the United States. (Bull. Geol. Soc. Am., Vol. 3, 1892.)

The Post-Laramie Beds of Middle Park, Colorado.—Mr. Whitman Cross, in a paper read before the Colorado Scientific Society in October, 1892, points out the unconformities that exist between the Middle Park Beds of Colorado and the underlying recognized Laramie formations, and calls attention to the difference in lithological characters. A study of specimens collected at different points show that a large series of andesite rocks strongly resembling those that constitute the Denver conglomerates take part in this formation. The Lignitic beds also resemble those of the Denver beds. In regard to the fossil plants Mr. Cross finds that 12 out of 21 species from the Middle Park beds occur in the Denver beds. These facts, the author believes, justifies him in correlating the Middle Park beds with the Denver, and he agrees with Mr. R. T. Hill in assigning them to the Post-Laramie group.

It has been suggested by Mr. J. B. Hatcher,[1] that in view of the fact that at least two species of Agathaumas have been described from the Denver beds, that it would be well to take into account the evidence from the vertebrate fauna before settling definitely the age of the beds under discussion. (Proceeds Col. Sci. Soc. 1892).

Marine Pliocene Beds of the Carolinas.—The tables of the Molluscan fauna of the Waccamaw and Croatan Beds of the Carolinas recently published by Dr. Dall, establish the presence of genuine Pliocene beds in both the Carolinas. The Pliocene of Tuomey and Holmes is shown to be based on a confusion of species belonging to at least two horizons, and hence the classifications based upon the supposed characters of this non-existent fauna may now be consigned to oblivion. (Trans. Wagner Free Inst. 1892.)

Geological News.—General.—Mr. Ralph S. Tarr has called attention to the resemblance between the terraces now forming on the

[1]Amer. Journal Sci., Feb., 1893.

Colorada River in Texas, and the older ones of the Connecticut River. He suggests that the modes of formation may be identical. In the one case the floods and sentiment supply arise chiefly from the climatic accident of desiccation, while in the other they are the result of glacial accident. (Am. Journ. Sci. July, 1892.)

M. E. Ficheur has added an important fact to the knowledge of the geology of northern Africa. He finds that on the northern flank of the Atlas Mountains in Blidah (Algeria), and throughout the extent of the region occupied by the Chiffa schists, there is an anteclinal fold affecting the whole sedimentary series, a fold long drawn out and turned toward the north. This phenomenon appears to be the result of a lateral thrust from the north against the resisting mass of the Chiffa schists which formed, to all appearance, an island in the Cretaceous Sea. This folding took place after the Cartéirenne period, and very probably after the Helvétien stage, for these beds are seen to be disturbed at the end of this range on the slopes of the spur on the left side of the Harrach. M. Ficheur is of the opinion that the folding is limited to the Blidah range. (Revue Scientifique, Feb. 1893.)

Paleozoic.—In his notes on the Devonian formation of Manitoba, Mr. J. F. Whiteaves remarks that in Manitoba the Stringocephelus zone is remarkably clearly developed, and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. (Geol. Mag., Feb., 1893.)—Mr. Rollin Keyes calls attention to a well defined Kinderhook fauna intercalated in the Burlington limestone in northeastern Missouri. The fossils, chiefly molluscan, are found in a heavily bedded white encrinital limestone with a peculiar white chert in nodules and irregular bands. The forms are all species which characterize the Kinderkook of Burlington, Iowa. This seems to be an illustration of Barrande's celebrated "doctrine of colonies." (Am. Journ. Sci., Dec., 1892.)

Mesozoic.—According to Mr. H. W. Fairbanks the granitic rocks of southern California are not Archean. They are present as intrusions squeezed into rocks varying in age from the Jurassic to Paleozoic inclusive at the close of the Jurassic. (Geol. Mag., Feb., 1893.)—— Mr. A. Smith Woodward reports the skeleton of a fish from the Oxford Clay of Wiltshire, England, which he "provisionally quotes as an immature example of *Ischyodus egertonii.*" The fossil tends to confirm the reference of *Ischyodus*-like fishes to the existing family of

Chimæridæ. (Ann. Mag. Nat. Hist., Jan., 1892.)——The fossil fragments of jaws and teeth described by Gervais under the name *Lepidosteus suessoniensis* have been referred by M. V. Lemoine to the genus *Champsosaurus* Cope. M. Dollo has recently published a critical comparison of Gervais' Lepidosteus with Champsosaurus to show that there is no point of resemblance between them, but that they present numerous and radical differences, and that Gervais' reference is correct. (Bull. Scien. de la France et de la Belgique, 1892.)

Cenozoic.—Señor Nogués, who has been exploring the Andesian volcanoes of Chillan, confirms the supposition of Pissis (*Geografia fiscia de la Republica de Chili*, 1875, Paris) concerning the existence of moraines of two distinct epochs, and therefore of glacial periods, one of them being anterior to the present volcanoes. This explains the orography of the region. (Geographical Journal, Feb. 1893.)——Mr. G. Cotteau, who is studying the fossil echinoderms of the Eocene of France, has recently described a number of new species belonging to the genera *Coptosoma* (Desor), *Liosoma* (Cotteau), *Micropeltis* (Pomel) *Circopeltis* (Pomel), and *Gagaria* (Duncan). The latter genus is represented in France by six new species belonging to the middle Eocene. (Revue Scien., Jan., 1893.)——Professor Cope recently exhibited to the Academy of Philadelphia a nearly entire mandible of the *Tetrabelodon shepardii* (*Mastodon shepardii* Leidy) from the Blanco (Pliocene) of Texas. He showed that it differs from the known species in the decurvation of the mandibular symphysis, which equals that of the corresponding part of the jaw of Dinotherium, but lacks the incurvature of that genus. He shows that the Mexican species formly referred to that species is distinct, and he proposed for it the name of *Mastodon oligobunis*.

BOTANY.

North American Fungi, Century XXIX.—Subscribers to Ellis & Everhart's North American Fungi were gratified recently by the receipt of the 29th volume of this great collection, with its neatly mounted and labelled specimens. It is one of the "miscellaneous" volumes, nearly all groups of the fungi being represented. Thus we find five Myxomycetes, among which is the new *Stemonitis virginiensis* Rex; the recently described *Peronospora echinospermi* Swingle; a dozen or so Uredineæ, some but recently described; *Erysiphe graminis* in fruit; many Pyrenomyceteæ, some Hymenomycetes, and a good many "imperfect fungi," the latter well represented by species of *Phyllosticta* and *Septoria*.—CHARLES E. BESSEY.

New York Fungi.—A new and interesting distribution of specimens of fungi has been undertaken by Mr. C. L. Spear, of Alcove, N. Y., under the title of "New York Fungi." It is designed particularly to illustrate the work of the well-known mycologist, Charles H. Peck, who, in the capacity of State botanist, has for so many years been engaged in the study of the fungi of New York. Century I contains the following species: *Amanita cæsaria* Scop., *A. phalloides* Fr., *A. muscaria* L., var. *alba* Pk., *A. vaginata* Bull., *Tricholoma album* Schæff., *Collybia radicata* Relh., *Mycena galericulata* Scop., *M. leaiana* Berk., *Omphalia campanella* Batsch., *Pleurotus sapidus* Kalchb., *Clitopilus cæspitosus* Pk., *Naucoria pruinatipes* Pk., *Hypholoma aggregata* Pk., *H. sublateritium* Schæff., *H. candolleanum*, Fr., *Coprinus picaceus* Fr., *C. micaceus* (Bull.) Fr., *C. plicatilis* (Curt.) Fr., *Lactarius deceptivus* Pk., *Cantharellus floccosus* Schw., *Marasmius oreades* (Bolt.) Fr., *M. rotula* (Scop.) Fr., *Panus stipticus* (Bull.) Fr., *Schizophyllum commune* Fr., *Lenzites betulina* (L.) Fr., *Boletinus pictus* Pk., *B. porosus* (Berk.) Pk., var. *opacus* Pk., *Boletus subluteus* Pk., *Polyporus perennis* (L.) Fr., *P. sulphureus* (Bull.) Fr., *P. fumosus* (Pers.) Fr., *P. adustus* (Willd.) Fr., *P. pubescens* (Schum.) Fr., *P. applanatus* (Pers.) Fr., *P. fomentarius* (L.) Fr., *P. conchatus* (Pers.) Fr., *P. hirsutus* (Wulf.) Fr., *P. pergamenus* Fr., *P. versicolor* (L.) Fr., *Dædalea confragosa* (Bolt.) Fr., *D. unicolor* (Bull.) Fr., *Glœoporus conchoides* Mont., *Hydnum zonatum* Batsch., *H. graveolens* Delast., *H. coralloides* Scop., *Irpex paradoxus* (Schrad.) Fr., *Phlebia zonata* B. & C., *P. radiata* Fr., *Craterellus cornucopioides* (L.) Fr., *Thelephora schweinitzia* Pk.,

Stereum rugosum Pers., *S. acerinum* (Pers.) Fr., *Hymenochæte corrugata* (Fr.) Lev., *Corticium salicinum* Fr., *Cyphella tiliæ* (Pk.) Cke., *C. fulva* B. & Rav., *Clavaria botrytis* Pers., *C. formosa* Pers., *C. stricta* Pers., *C. fusiformis* Sow., *Spathularia flavida* Pers., *Guepinia spathularia* (S.) Fr., *Lycoperdon gemmatum* Batsch., *L. pyriforme* Schæff., *Scleroderma vulgare* Fr., *Phragmidium subcorticium* (Schrank.) Wint., *Puccinia peckiana* Howe, *P. graminis* Pers., *P. circæa* Pers., *P. pimpinellæ* (Strauss) Lk., *P. sorghi* Schw., *P. malvacearum* Mont., *P. mariæ-wilsoni* Clint., *P. fusca* (Relh.) Wint., *P. podophylli* Schw., *Uromyces junci* (Desm.) Tul., *U. polygoni* (Pers.) Fckl., *U. hyperici* (Schw.) M. A. Curt., *Ræstelia lacerata* (Sow.) Fr., *Æcidium clematidis* DC., *Ustilago caricis* (Pers.) Fkl., *U. avenæ* (Pers.) Jensen, *U. erythronii* Clint., *U. utriculosa* (Nees) Tul., *Sphacelotheca hydropiperis* (Schum.) Schrot., *Urocystis waldsteiniæ* Pk., *Microsphæra alni* (DC.) Wint., *Hypocrea richardsoni* B. &. M., *Hypomyces lactifluorum* Schw., *Diaporthe acerina* (Pk.) Sacc., *Hypoxylon fuscum* Fr., *H. blakei* B. & C., *Pezicula carpinea* (Pers.) Tul., *Cenangium cerasi* (Pers.) Fr., *Patellaria rhabarbarina* Berk., *Sphinctrina tigillaris* B. & Br., *Monilia fructigena* Pers., *Coniosporium rhizophilum* (Pr.) Sacc., *Trimmatostroma americanum* Thüm., *Septoria œotheræ* West.—CHARLES E. BESSEY.

Seymour and Earle's Economic Fungi.—The fifth fascicle of this set was distributed February 1st, 1893. It includes numbers 201 to 250, represented chiefly by Uredineæ parasitic on woody plants, many numbers (226 to 250) being devoted to the gymnosporangia, with their aecidial stages. Accompanying the set is a systematic list of hosts, from which one learns that the 50 species of fungi are parasitic upon 35 hosts, representing 13 families of flowing plants.

Of the usefulness of this set to students of the injurious fungi, little need be said. It is simply indispensable.—CHARLES E. BESSEY.

Halsted's Weed-Seeds.—One of the most useful sets of specimens recently distributed is the "One Hundred Species of American Weed-Seeds," issued by Dr. B. D. Halsted, of New Brunswick, N. J. It consists of 100 small screw-capped vials, each containing a good quantity of cleaned seeds or achenes, in the condition in which they usually occur as impurities in horticultural and agricultural seeds. It supplements most admirably the two centuries of "American Weeds," issued by the same author.—CHARLES E. BESSEY.

Morong's Naiadaceæ.—Students of the *Naiadaceæ* will be greatly helped by the sets of named specimens which Dr. Thomas

Morong, of Columbia College, is now distributing to subscribers. A set recently received contains 83 North American and European species and varieties, representing quite satisfactorily this difficult group. When the author's "Revision of the North American Naidaceæ," now in the press, is received, there will be little reason for students and collectors neglecting these interesting acquatics.—CHARLES E. BESSEY.

Canadian Mosses and Lichens.—Several years ago, Dr. John Macoun began the distribution of sets of "Canadian Musci," from material secured in his extensive collecting expeditions in the vast forests of the north and west. During the winter the fifth century came to hand, including numbers 501 to 600, some of which are interesting new species.

With this century of mosses came Century I of "Canadian Lichens," which promises to be fully as interesting a distribution as the other. The specimens are ample, and the labels are of the same neat style as those of the mosses.—CHARLES E. BESSEY.

ZOOLOGY.

The New England species of Balanoglossus.—In 1873, Alex. Agassiz described a Tornaria from New England which he ascribed to the common Balanoglossus of the region. Bateson later, studying in Virginia and North Carolina, showed that in *B. kowalevskii* there is a direct development. The question at once arose, what form did Agassiz have? Either his Tornaria did not belong to *B. kowalevskii* or the same species has a different development in different regions. Now Prof. T. H. Morgan announces[1] that he has found Bateson's larvæ with the *Balanoglossus kowalevskii* on the southern coast of New England. This clears up one problem but it still leaves the origin of the Tornaria questionable.

Marsipobranchs.—Beard reports[2] that in young Myxines in which the pronephros was functional, the teeth were present in several rows upon the roof of the mouth. Apparently there is no Ammocete stage, but there is a metamorphosis. He further finds that at least in one specimen of a male Petromyzon in about one section in forty of the testis there was a well marked ovum, occupying a follicle for itself.

The Lateral Line of Siluroids.—Pollard has been tracing the cephalic divisions of the lateral line system in several Siluroids[3] and while his work is largely descriptive and admits of no abstract, one is struck with the support he brings to the old view of Huxley that the Arthrodira are near relatives of the Siluroids and especially to the close affinities of Clarias and Coccosteus. The parallels in the canals of the two forms are very exact. On the other hand Pollard points out a close resemblance between the African genera Clarias and Auchenaspis and the South American, Chætostomus. The facts remains, that while careful studies of the lateral line like these of Pollard may in future throw much light upon the phylogeny of various groups of fish-like forms, we have as yet not data enough for much generalization.

Prodromus of a new System of the non-venomous Snakes.—The unsatisfactory character of the existing classifications of the

[1] Zool. Anz. XV, 456, 1892.
[2] Anat. Anz. VIII, p. 59, 1892.
[3] Zoolog. Jahrbüches, VI, 1892.

non-venomous snakes is well known. That authors are not agreed as to the principles on which these animals should be classified may be learned by comparison of the systems published by Duméril and Bibron in 1853, Günther in 1858, myself in 1886 (Proceeds. Amer. Philos. Society), and Boulenger in 1892 (Reptilia of Zoology of British India). It had appeared evident to me that a further examination of the anatomy of these reptiles is necessary before a correct account of their mutual relations can be given, and that the organs of the reproductive system especially, were likely to yield important results. With the object of obtaining light on this question, I have made an examination of the hemipenis, and have obtained valuable indications of relationship which have been hitherto unknown. I have had the opportunity of examining material from the collections of the Academy of Philadelphia, of the U. S. National Museum, and of my own cabinet. I present here a general synopsis of the results, reserving for a future occasion the publication of a fuller illustrated memoir on the subject. The resulting classification is more in harmony with the systematic indications obtained from the study of other vertebrata, than those hitherto adopted, which is itself an indication of its greater approximation to nature. Some points remain obscure, and many details are omitted from the present prodromus.

The hemipenis of the Ophidia is traversed by a groove which divides the muscular investment to the internal integument (or external integument when the organ is retracted), which commences at the base internally, and soon turns to the external side of the organ and continues to its extremity. This is the sulcus spermaticus. This sulcus is always bifurcated in venomous snakes, and I find it to be equally bifurcated in many harmless snakes. The investing tissues may or may not correspond with this bifurcation. Thus the hemipenis may be more or less bifurcate. Schlegel states that it is bifurcate in venomous snakes, but it is not so in *Hydrophis hardwickii*, *Bungarus semifasciatus*, *Hoplocephalus coronatus*, etc., while it is bifurcate in many non-venomous forms. Next to the bifurcation of the sulcus in importance, is the nature of the surface of the external investment (internal when retracted). In the most perfect types both venomous and non-venomous, this surface is reticulate like tripe, the enclosed areas forming calyces, which may have a suctorial function. Their borders are generally papillose, and are sometimes so deeply divided into papillæ as to lose their original character. These papillæ may be the seat of osseous deposit, becoming bristles or spines, which become larger toward the middle of the length, and lose their mutual membranous connections. These isolated spines

may extend to the apex, but they rarely extend to the base. The surface may, however, be laminate and not recticulate, and the laminæ may be longitudinal or transverse. In either of these cases they may not be spiniferous. The apex or apices of the organ may be furnished with a rigid papilla or awn. The entire surface of the organ when protruded, is designed for the maintainance of its position in the oviduct of the female, from which it cannot be withdrawn, excepting by invagination.

In the Tortricina and Peropoda, the hemipenis is not spinous, and the sulcus is bifurcate, and in the Boidae the hemipenis is bifurcate also, although in some genera (Xiphosoma, Ungualia), the branches are very short. The external integument is never reticulate, but is always laminate with elongate papillæ at the extremities, in Epicrates, Xiphosoma, and Ungualia. The laminae are pinnate from the sulcus as an axis, in Morelia, Enygrus, Lichanura and Eryx, and are transverse in Charina. In Ilysia they are pinnate, with a few longitudinal plicæ below.

The general definitions of the families exclusive of the Peropoda are as follows.

No spines; surface longitudinally plicate; *Calamariidæ.*

The surface of the hemipenis is flounced more or less transversely; *Lycodontidæ.*

The surface is more or less reticulate, and the sulcus spermaticus is undivided: hypapophyses anterior; *Colubridæ.*

The surface is reticulate or longitudinally plicate, and the sulcus is divided; hypapophyses anterior; *Xenodontidæ.*

The surface is neither reticulate nor flounced, and the spines when present are disconnected; hypapophyses continued to caudal vertebræ; *Natricidæ.*

The Calamariidæ approach in the characters of the hemipenis to such Peropoda as Eryx. The character assigned to the Lycodontidæ is more or less distinctly present in the typical or Solenoglyph venomous snakes; while the Najidæ (exclusive of Elapidæ) on the other hand, cannot be distinguished from the Xenodontidæ, by any general character. The Lycodontidæ are Old World with a single genus in America; a distribution resembling that of the Pythonidæ. The Colubridæ inhabit the Old World and North America, a few genera entering South America. The distribution is like that of the firmisternial Salientia. The Xenodontidæ are of South America and Madagascar, a few genera entering Africa and North America, a distribution nearly like that of the Iguanian lizards. The Natricidæ are distributed in the Northern Continents, very few types occurring in Africa and none in South America.

It will be observed that all of the families include burrowing types, and that the Colubridæ and Xenodontidæ include also arboreal types. This result is in accordance with the general rule that adaptations to present environment are not indications of the deepest affinities. All the families include glyphodont genera. The genera included in these families are the following:

CALAMARIIDÆ.

In *Calamaria gervaisii* the plicæ are well developed. Species formerly referred to Simotes belong here. In *Holarchus*[4] (Cope) *ancorus*, the sulcus is undivided, and the distal part of the external side is membranous. In the *H. trinotatus* the sulcus and hemipenis are shortly bifurcate, for which reason I refer it to a distant genus under the name of Dicraulax. I have had access to very few types of this group, and consider the present arrangement provisional.

LYCODONTIDÆ.

I. Aglyphodont; sulcus spermaticus undivided.

No palatine or pterygoid teeth. (In *Oligodon subquadratus* the only species of the genus examined, there are two robust papillæ on the extremity of the hemipenis); *Oligodontinæ.*

Hemipenis simple; palatine and pterygoid teeth; *Lycodontinæ.*

II. Aglyphodont; sulcus spermaticus, and generally hemipenis, bifurcate; *Boodontinæ.*

III. Glyphodont; sulcus and hemipenis bifurcate; *Cantoriinæ.*

IV. Glyphodont; sulcus simple; *Uriechinæ.*

To the Lycodontinæ belong Lycodon and Anoplophallus (=Megalops Hallow.) which has a long loreal and no preocular plate, and no spines on the hemipenis. To the Boödontinæ belong Boödon and Lamprophis; to the Uriechinæ, Uriëchis and the sole American genus, Stenorhina. The typical genus of each of the other subfamilies are the only ones I have been able to examine. The Oligodontinæ may belong to the Calamariidæ.

COLUBRIDÆ.

The subfamilies are as follows:

Aglyphodont; hemipenis reticulate; *Colubrinæ.*

Glyphodont; reticulate; *Dipsadinæ.*

Glyphodont; longitudinally laminate; *Chrysopeleinæ.*

The COLUBRINÆ are either burrowing (fusiform), terrestrial (colubriform), or arboreal (attenuate), and are so grouped for convenience.

[4] Bulletin, U. S. Natl. Museum, 32, 1887, p. 54.

Fusiform. Chilomeniscus; Ficimia; Geagras; Cemophora; Rhinochilus; Conopsis (has papillæ at the apex in addition to a few cups).; Stylosoma (spinous nearly to apex.)

Colubriform. Contia; Hypsiglena (pocketed below apex); Proterodon; Dianodon; Coronella; Ophibolus; Rhinechis; Phyllorhynchus (four rows of spines dividing calyculate apex); Salvadora; Symphimus; Epiglottophis; Pityophis; Spilotes; Coluber; Bascanium; Drymobius; Zamenis; Ptyas; Herpetodryas; Cyclophis; Liopeltis; Cynophis (has a terminal papilla which is produced into an awn); Crossanthera, (g. n.) established for *Deudrophidium melanotropis* Cope, on account of the total division of the walls of the small cups into papillæ.)

Attenuate. Dendrophis; Leptophis; Bucephalus; Dasypeltis (papillæ spinous to apex.)

In the DIPSADINÆ the same gradation appears.

Fusiform. Tantilla; Scolecophis; Ogmius (spines to apex).

Dipsadiform; (generally pocketed below apex). Sibon; Trimorphodon; Crotaphopeltis; Himantodes; Rhinobothryum; Dipsas.

Attenuate. Cladophis; Oxybelis; Dryophis (has a diverticulum simulating a bifurcation of the hemipenis); Tragops; Passerita.

The CHRYSOPELEINÆ includes only the genus Chrysopelea, so far as I have examined.

Genera of Colubridæ in which the calyces are not papillose, are Phyllorhynchus, Hypsiglena, Dianodon, Proterodon, Coronella, Symphimus, Dendrophis, Crotaphopeltis and Dipsas.

XENODONTIDÆ.

The arrangement of the genera of this family is difficult, and what is presented here is only tentative. It seems probable that some genera with a grooved posterior tooth are more nearly allied to others with a smooth tooth than to each other; but on the other hand the external form of the animal is a poor guide, as all forms pass into each other. So also the reticulate or plicate character of the integument of the hemipenis. Many of the genera may be distinguished by details of structure. As before, I designate the general forms as fusiform, colubriform, attenuate, and dipsadiform; and for the present I adopt two subfamilies.

Aglyphodont; *Xenodontinæ.*

Glyphodont; *Scytalinæ.*

XENODONTINÆ.

Fusiform. Catostoma; Carphophiops; Farancia*†; Pseudoeryx; Ninia.

Colubriform. Homalosoma†; Grayia; Theleus g. n.; Diadophis; Rhadinæa; Pliocercus; Opheomorphus*; Liophis*; Dromicus; Alsophis; Lianthera g. n.; Hypsirhynchus*; Amastridium; Helicops; Xenodon*; Acanthophallus†; Lystrophis*; Heterodon.

Attenuate. Uromacer.

Dipsadiform. Leptognathus†, Mesopeltis†.

The genera of this subfamily in which the surface is exclusively longitudinally plicate are marked with a star; on the other genera it is more or less reticulate. The genera in which the extremity is spinous are marked with a †. In Theleus the hemipenis is simple, and its apex is covered with short separate papillæ, below which it is coarsely spinous; type *Boodon virgatum* Hallow. from W. Africa. Lianthera is established on *Herpetodryas bernieri* of Madagascar, and related species, on account of the absence of calyculi, and weak development of spines of the hemipenis, and the isodont dentition. The genus Acanthophallus is designed to include the species formerly referred to Xenodon in which the hemipenis is spinous to the extremity. The type is *X. colubrinus* Gthr; the anal plate is entire. In Xenodon the extremity is smooth and plicate, and the anal plate is divided.

SCYTALINÆ.

Fusiform. Hydrocalamus.†

Colubriform. Pseudophis; Erythrolamprus*; Tachymenis†; Coniophanes; Conophis; Rhinostoma; Scytale; Oxyrrhopus; Tomodon†; Thamnodynastes (includes *Tachymenis hypoconia* M.), Tropidodryas; Philodryas; Jaltris.*

Attenuate. Langaha.

As in the Xenodontinæ, genera with the apex plicate only are marked with a star, and those with a spinous apex are marked with a dagger. The only species of Tomodon I have examined is the *T. ocellatus*, which is not the type. The position of Langaha I am not satisfied about, as it may be an attenuate form of the Natricidæ.

NATRICIDÆ.

This family, which I first defined from vertebral characters, is generally easily distinguished from the others by the characters of its hemipenis. This organ is never reticulate, and the spines are always small or rudimental. When present they originate in fossæ of the integument and are never connected by tegumentary folds, except when they sometimes stand on longitudinal plicæ. The aglyphodont genera (except the Pseudaspidinæ) make up for the deficiency of the spines, by the presence of one or two large hooks on one side of the sulcus spermaticus at the base. The sulcus is variable, being sometimes simple, and sometimes bifurcate. The subfamilies are as follows:

¶Glyphodont.	Spines better developed; no basal hook;	*Homalopsinæ.*
¶Aglyphodont.	Spines rudimental; no basal hook;	*Pseudaspidinæ.*
¶Aglyphodont.	Spines rudimental; a basal hook.	*Natricinæ.*

Of the HOMALOPSINÆ only the genera Homalopsis, Herpeton, and Cerberus have come under my observation; but I suppose that Hypsirhina and other allied Asiatic genera will be found to present the same characters. In both genera the sulcus is bifurcate, and the hemipenis divided.

I have been able to examine but one genus of the PSEUDASPIDINÆ, viz., Pseudaspis Cope (type *Coronella cana* L.), but I suspect that Ablabes (*A. rufulus*) which is African, belongs here. In Pseudaspis the sulcus is bifurcate, and the hemipenis is divided almost to the base, quite as in the most specialized Solenoglypha.

NATRICINÆ.

This natural group includes fusiform and colubriform genera, and presents great variations in the form of the hemipenis. The Asiatic species have that organ bifurcate, while in the European and American water snakes it is simple.

Fusiform. (Hemipenis simple). Haldea; Tropidoclonium (the apex with a pair of robust papillæ as in Oligodon;) Virginia.

Colubriform. I. Sulcus and hemipenis undivided. Storeria; Eutænia; Natrix; Clonophis; Liodytes. II. Sulcus and hemipenis divided. Diplophallus, g. n. (type *Tropidonatus piscator* Schneid.; has syncranterian dentition, and no apical papilla); Amphiesma; Ceratophallus (established on *Tropidonotus vittatus* on account of the presence of a rigid papilla on the apex of each branch of the hemipenis.)

Similar gradations in the characters of the hemipenis are to be seen in the types of venomous snakes. Thus in the Proteroglypha this organ is spinous to the tip, on a calyculate basis, in Hydrophis, Elaps, (*surinamensis*); Dendraspis. It is reticulate at the extremities and spinous below, in Callophis (*bivirgatus*); Naja; Acanthophis; Bungarus and Sepedon; the apex smooth in the two genera last named. In *Elaps nigrocinctus* the organ is usually smooth, with a few spines at the apex.

In Solenoglypha the genus Atractaspis is spinous to the apex, apparently on a longitudinally laminate basis. In the Viperidæ and Crotalidæ the spines are on a flounced basis. The apices are calyculate in Bitis, Clotho, and Vipera, and spinous in Cerastes. They are calyculate in Crotalidæ in Bothrops, Ancistrodon, Crotalophorus, Crotalus and Uropsophus. In Crotalus (*durissus* of the Neotropical fauna), the median spines are replaced by papillæ, in all the other genera they are spinous.—E. D. COPE.

Zoological News. PROTOZOA.—Prof. August Gruber, in a note on nuclear multiplication and swarm formation in the Freshwater Rhizopoda[5] describes an Arcella in which milotic cell division occurred. He also figures Arcella with 19 and 32 nuclei, and *Lecythium hyalinum* with eightnuclei. These facts are adduced in evidence that among the fresh-water Rhizopods reproduction by spore formation coexists along with simple fission. In other cases Gruber found small bodies in Arcella tests which at first sight might be taken for swarm spores but which are none other than parasitic Amoebæ.

WORMS.—Nachtrieb and Barrows are studying the leeches in Minnesota. In a preliminary note[6] Mr. Barrow states that they have found 11 species of Gnathobdellidæ, 10 of Rhynchobdellidæ and 1 of Branchiobdellidæ. It is noted that two species of Aulostoma can be distinguished by the fact that in the one the right sperm duct passes under the nerve cord; in the other the left. A final report is promised.

Henry B. Ward reports[7] the host of *Nectonema agile*.[8] Dr. McMurrich found a worm, like Nectonema except that it lacked the lateral bands of setæ, characteristic of the adult, in the thoracic cavity of Palæmonetes. This when studied by Dr. Ward, proved to be a female Nectonema.

MOLLUSCA.—H. Suter enumerates 142 species of land molluscs, 32 fluviatile, and 18 brackish water species, in New Zealand.

According to C. Hedley, *Parmacochlea fischerii* collected by the "Challenger" expedition is most nearly allied to Helicarion.

[5] Ber. Naturf. Gesellsch. Freiburg, VI, 114, 1892.

[6] Quarterly Bulletin, Univ. Minnesota I, p. 87, 1893.

[7] Proc. Amer. Acad. Arts and Sci. 1893, p. 260.

[8] See AMER. NAT. XXVI, 1037, 1892.

EMBRYOLOGY.[1]

Germ-layers of Vertebrates.[2]—Basilius Lwoff has extended his work upon the germ-layers of Amphioxus[3] to other vertebrates and put forth a preliminary paper that arouses in us a lively interest in the final detailed account that is to contain both his own discoveries and a discussion of the literature of the subject.

In the present paper he makes statements directly contrary to some opinions that up to the present time we have supposed to be well-founded in fact.

Besides Amphioxus, he has studied the formation of the germ-layers in Petromyzon, the Axolotl, Pristiurus, Torpedo, Labrax, Julis, Gobius, and Lacerta. He regards the Chordata as derived from a gastrula-like ancestor. Gastrulation is defined as the process by which the gut is formed, and the entoblastic cells are those which form the gut, whatever else they may produce. In Amphioxus and Vertebrates with holoblastic eggs, cleavage results in a blastula, one-half of which is composed of micromeres, the other of macromeres. Owing to the continued more rapid multiplication of the micromeres, they cover and grow around the macromeres. When the blastula is single layered, as in Amphioxus, this results in the invagination of the macromeres, where it is several layered, as in Petromyzon and the Amphibia, they are simply surrounded by the micromeres.

The macromeres form the gut and are therefore entoblast, while the micromeres form the outer covering and are therefore ectoblast. But there can be no distinction between entoblast and ectoblast until the micromeres have surrounded the macromeres. Besides this process of gastrulation there is a *dorsal invagination* that has nothing to do with the formation of the gut, but forms the whole ectoblastic rudiment of the chorda and the mesoblast.

The blastula of Petromyzon contains an extensive cleavage cavity, the roof of which is composed of micromeres and the floor of macromeres. The former multiplying more rapidly, grow around the latter. At the same time a new cavity is sunk into one side of the embryo, the roof being formed of invaginated ectoblast, while the floor is com-

[1] This department is edited by E. A. Andrews, Johns Hopkins University.

[2] Biol. Centblt. 13, 1893, 40–50, 76–81.

[3] See AMERICAN NATURALIST, March, 1893, p. 228.

posed of entoblast that has not been invaginated. As in Amphioxus, this invaginated ectoblast forms the chorda and part of the mesoblast, while the entoblast forms the rest of the mesoblast as well as the gut.

Nearly the same process, according to Lwoff, takes place in the Axolotls. But here the dorsal invagination begins, while the micromeres are growing over the macromeres, and the ectoblastic rudiments of the mesoblast never form part of the roof of the enteric cavity. In the frog, however, Morgan[4] and Robinson and Assheton[5] seem to have found good evidence that the micromeres do not grow around the macromeres, but that the superficial ones of the latter are themselves gradually split up into micromeres, so if we are to accept Lwoff's interpretation of the dorsal invagination, the gastrulation in this form may better be described as being by delamination than by an epibolic process. Moreover, according to the apparantly accurate work of Robinson and Assheton, there is no invagination of the ectoblast in the frog.

In Selachians and Teleosts, Lwoff believes the entire entoblast arises from the yolk-elements, that is, the periblast. This is surprising in view of the many statements to the contrary, especially H. V. Wilson's[6] work on the sea-bass. Lwoff finds the chorda and part of the mesoblast to be formed from the same elements as the nervous system. The entoblast also takes part in the formation of the mesoblast.

In Lacerta, cleavage results in a two layered germinal disc. The inner layer becomes the entoblast. An invagination from the outer layer forms the chorda and part of the axial mesoblast. The rest of the axial and the peripheral mesoblast is of entoblastic origin.

The process in the formation of the germ layers throughout the Vertebrates is practically the same as in Amphioxus, except that there is no invagination to form the entoblast, and there are, therefore, no gastrula lips. There is but one point in the embryo that is homologous in all Vertebrates, and that is the point where the ectoblastic invagination begins. The so-called neurenteric canal does not lie between the neural canal and the archenteron, but between the former and the chorda, and shows their intimate connection—R. P. B.

The Mantle of Ascidians.—In studying live specimens of larval Phallusia, A. Kowalevsky[7] at first thought with Hertwig, Sem-

[4] AMER. NAT., Aug., 1891, p. 753.

[5] Quart. Jour. Mis. Sci., 32, 1891, p. 451.

[6] Bul. U. S. Fish. Com., 9, 1891, p. 209.

[7] Mem. l'Acad. Imp. Sci. St. Petersburg, 7, 37, No. 10, 1892.

per, Maurice and others, that the mantle of this ascidian should be regarded as an epidermis-like structure, a thickening of the ectoderm with large amounts of intercellular material between the ectodermal cells.

On studying sections of this larva, however, he obtained evidence that mesodermal cells migrate out through the epidermis of the larva into the thick hyalin cuticle or secreted mantle matrix, and thus supply mesodermal cells as the fundamental cells of the mantle.

These migrating cells the author would regard as a sort of phagocytes and imagine to have a primary function in destroying the injurious parasites, bacteria, etc., that would easily lodge in the secreted mantle matrix.

In the same paper there is an interesting account of the degenerative changes that the tail of the larva undergoes when free life is given up. After peculiar histological transformations in the notachord and muscles of the tail, these cells and the epidermal cells pass into the body. The last of the tail is drawn in by an actual hollow invagination that forms a closed vesicle in the body. The ultimate changes in the muscle cells are accompanied by the activity of clusters of phagocyte-like mesoderm cells.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 5.—The following paper was read by Professor George Lincoln Goodale: "On some aspects of Australian vegetation." It was illustrated with stereopticon views.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences. Biological Section.—March 13, 1893.—Professor T. D. Quackenbos, in a paper on the Saibling of Lake Sunapee, distinguishes, in this, a fourth variety of New England Charr, demonstrating that the present abundance of this *Salvelinus* is accounted for not from its introduction and natural increase, but from destruction of inimical forms within recent years which has given a greater available food supply. Professor G. S. Huntington, on "Anomalies of Pectoralis major and minor," referred to the value of these as often presenting reversions. He emphasized the evolutionary tendency in man to proximalization of the points of attachment of the shoulder muscle group, referred to cleavage variations in anterior portion of brachiocephalic sheet, and compared these with ontogenetic characters in Anthropoids. Human anomalies in this group are best interpreted by Cynocephaloids, and not by the higher forms. Professor E. B. Wilson, "On Regeneration and the Mosaic Theory of Development," presented a brief critique on the latest results of Rous and Weissman.

BASHFORD DEAN, *Secretary.*

Natural Science Association of Staten Island.—February 18.—A series of twenty photographs of Staten Island trees were shown by Dr. N. L. Britton—duplicates of the set taken by Mr. Romeyn B. Hough, for the State Forestry exhibit at the Columbian Exposition, as mentioned at the meeting of October 15, 1892.

Mr. Joseph C. Thompson stated that since the last meeting he had made another bacteriological examination of the Crystal Water Company's water, from a sample taken from a hydrant at the corner of New York Avenue and Cliff Street, and found 185 individual bacteria per cubic centimetre. The temperature of the water was 34° Far. As previously stated, the New York City Croton water contains about 12,000 per cubic centimetere.

Mr. Arthur Hollick presented a piece of ferruginous sandstone, containing impressions of dicotyledonous leaves. The specimen resembles those found in the Drift, at Tottenville and Princes Bay, which are known to be derived from the Cretaceous clays. The specimen in question, however, was found as a Drift rock on the Serpentine hills, to the north of the Cretaceous area. It is possible that it may have been brought to the place where it was found by human agency, but if not, its occurrence there is more or less of a problem which future discoveries may solve. It is desired, at present, merely to place the fact upon record.

The Biological Society of Washington.—March 11.—The following communications were made: Dr. Frank Baker, "Recent Discoveries in the Nervous System;" Mr. Vernon Bailey, "The Burrow of the Five-toed Kangaroo-Rat;" Mr. E. M. Hasbrouck, "The Breeding of the Bald Eagle near Mount Vernon"—with exhibition of Eggs.

March 25.—The following communications were made: Mr. L. M. McCormick, "A Hybrid between *Pyranga rubra* and *Pyranga erythromelas*;" Prof. E. W. Doran, "Development of the Intestine of Tadpoles;" Dr. Theobald Smith, "The Bacteriology of Potomac Water and its Bearing on Sanitary Problems;" Mr. B. T. Galloway, "Experiments in Preventing Rusts Affecting Cereals."

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Feb. 21.—The following papers were read: "The Foundation of the Zuni Cult," Mrs. Matilda Coxe Stevenson; "Dual Civic Functions: a study in the evolution of institutions," Miss Katie Foote; "Early Man in the Mississippi Valley," Mr. Thomas Wilson.

WESTON FLINT, *Sec'y Board of Managers.*

SCIENTIFIC NEWS.

At the meeting of the Geographical Club in the Hall of the Academy of Natural Sciences of Philadelphia, it was announced that the result of the balloting among the members of the club upon the question of active co-operation in the proposed new expedition to the Arctic regions under the lead of Lieut. R. E. Peary, stood in favor of the project.

The proposed expedition will involve an expenditure of from $20,000 to $25,000. The expenditure covers two northern voyages. The first to land Peary and his party, and the second to bring it back upon the completion of its work. An auxiliary summer expedition is to be organized to take charge of the ship on her second voyage, the movements of the vessel to be under the control of the Geographical Club.

The design of the expedition is the complete determination and delineation of the detached land masses lying to the north of main Greenland. The second object will be the determination of the unknown portion of the east coast of Greenland, extending from Independence Bay to Cape Bismarck, the most northern point sighted by the German expedition in 1870. The third object will be the determination of the transverse profile of the Greenland inland ice cap, from Cape Bismarck to Inglefield Gulf.

Other aims of the expedition will be the complete detailed survey of Whale Sound and Inglefield Gulf, with studies and measurements of the glaciers in that region, and their parent ice cap; a continuation of the study of the little tribe of Arctic Highlanders. As complete collections as may be practical will be made of the natural objects of the region, and more or less extended meteorological and tidal observations carried on.

The amount of funds to be contributed by the Geographical Club will be from $8,000 to 10,000.

Botanists will hear with regret of the death at Brighton, Jan. 18, of Dr. Benjamin Carrington, the highest authority on British Hepaticæ.

The State of Iowa has assumed the expense of the publication of the papers and proceedings of its Academy of Sciences, the Legislature having made an appropriation for that purpose at its last meeting.

Professor A. M. Miller has been appointed to take charge of the department of Geology which has just been established in the State College of Kentucky, at Lexington.

Mr. John Eyerman has presented to the Princeton Museum a set of casts of *Rhytina gigas* Linn., after the originals in the British Museun. The number of casts is 20, that of the cranium, measuring 2¼ feet, being the largest.

M. Johnston-Lavis has been appointed Professor of Vulcanology at the University of Naples. A similar chair existed at Catania, but it was abolished at the death of its occupant, M. Silvestri.

Mr. G. W. Lichtenthaler, one of America's most eminent conchologists, died in San Francisco. Feb. 20, 1893. For 20 years he had been a traveler and collector in almost every sea and country. During this time he brought together a large collection of specimens, which he bequeathed to the Illinois Wesleyan University, in his home city, Bloomington, Ill.

The collection embraces mainly shells, sea algae and ferns. His shells have been estimated conservatively at from six to ten thousand species, including thousands of duplicates. They embrace the Hemphill collection which he purchased, a large collection from the Hawaiian Islands, which he visited often; many from the Micronesia, Australia, Japan, the coasts of Europe, and America, and from every part of the United States.

The sea algae contain about a thousand species, all mounted in books and identified, and a large number of duplicates. They were collected from both coasts of America, from north to south, a large number from England, and many from other countries.

There are about 500 species of ferns, including the many duplicates. They represent a complete collection of the ferns of the Hawaiian Islands, and almost a complete collection of those of the United States, besides many from Europe, Asia, Australia, South America, etc.

He has also brought together many mosses and lichens, the number of which cannot be given with precison, but there are several hundred species.

The Marine Biological Laboratory of the Johns Hopkins University will be located this Summer at Port Henderson, Kingston Harbor, in the island of Jamaica.

Dr. R. P. Bigelow, present holder of the Bruce Fellowship with Messers Lamb, Siegirfuss and Lefevre left Baltimore, April 20, by a fruit steamer for Port Antonio, whence they will go to Kingston to open the Laboratory. Others with the Director, Professor W. K. Brooks expect to go down there later.

CAMBRIDGE, MASS., April 15, 1893.

THE Faculty of the MUSEUM OF COMPARATIVE ZOOLOGY will receive applications from candidates desiring to occupy the table at the NAPLES ZOOLOGICAL STATION, which has been placed at its disposal from October 1, 1893.

The applicant must be (or have been recently) a student or instructor

at some American University, preferably a person who has taken the degree of Ph.D. or S.D.; he must have published some creditable original investigation, and should be recommended as an able investigator by the professor under whom he has studied.

Applicants will please forward to the undersigned, before May 10 their recommendations and a statement of their qualifications and of the subject to which they hope to devote themselves.

In order that the Faculty may make the most satisfactory disposition of the table during the whole year, the applicants are requested to state the length of time they desire to remain at Naples, and also the earliest and latest dates within which they can avail themselves of the appointment.

The Faculty will, at its meeting in May, nominate to the Corporation of Harvard College for approval the incumbent or incumbents for the year 1893–1894.

ALEXANDER AGASSIZ,
Director.

The North American Review. Table of Contents for April, 1893.—*Charges at the World's Fair*—by Director-General Davis. Brain Surgery—Dr. William A. Hammond. Shipbuilding Here and Abroad—Naval Constructor Hichborn, U. S. N. Good and Bad Mothers—Mrs. Amelia E. Barr. *How Shall the Pension List be Revised?*—by Representative Wilson, of Missouri, Chairman of the Committee on Pensions; Gen. S. S. Burdett, Past Commander-in-Chief of the Grand Army of the Republic, and Col W. C. Church, editor of the "Army and Navy Journal." Art of Mystery in Fiction—George Manville Fenn. The Interior of the Earth—George F. Becker, of the United States Geological Survey, Two Englishwomen on America—1. by Lady Grey-Egerton; 2. by Lady Sykes. Faults in our Consular Service—the Hon. Robert Adams, Jr., Ex-Minister to Brazil. After Death—What?—the Rev. Charles F. Dole. The Negro as a Mechanic—the Hon. Robert Lowry, Ex-Governor of Mississippi. Middle-Class Life in France—the Marquise de San Carlos. *The Financial Situation*—1. The Currency and the Democratic Party—by the Hon. R. P. Bland, Chairman of the Committee on Coinage, etc.; 2. The Brussels Conference Reviewed—by the Hon. Charles Foster, Ex-Secretary of the Treasury. *Notes and Comments.*—"By Women for Women"—Lillian A. Mercur. Do the Fittest Survive?—W. A. Croffut. The Abuse of Secrecy—Clara Dixon Davidson. English Poor Law Reform—Edward Porritt.

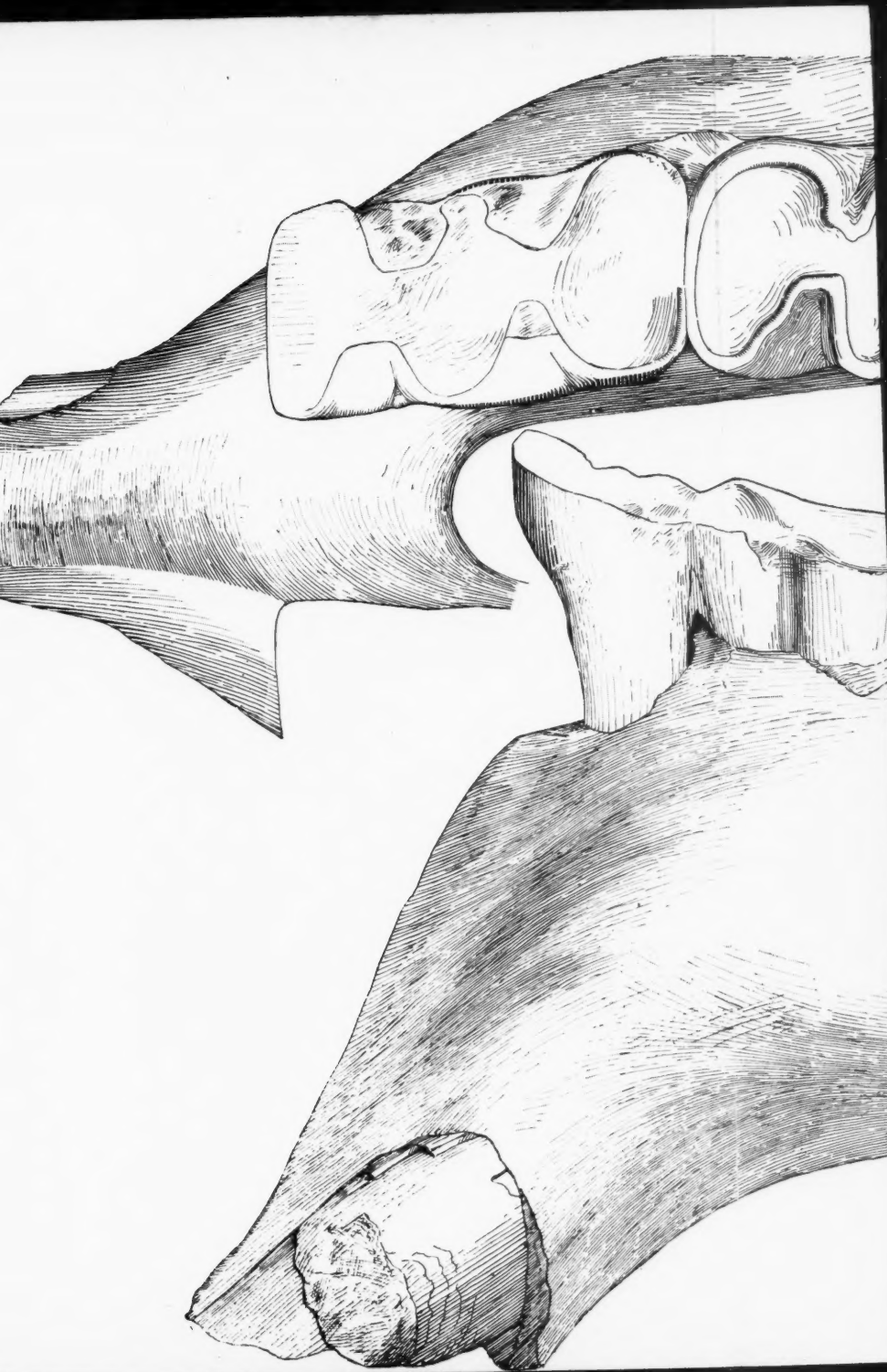

PLATE XII.